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Tank Control and Devitrification[1]

By Herbert Insley

Glass manufacturers know that variations of temperature during melting, fining and molding affect the working properties of the glass and are beginning to realize that accurate temperature control is important in maintaining uniform working conditions. The importance of temperature control in the prevention of devitrification is often overlooked. Accurate batch control is, of course, essential, but it would be of inestimable value if the glass technologist knew to what extent he could vary batch compositions without changing temperatures in tanks or at the machines and still prevent devitrification.

Given sufficient time, all glasses will crystallize if held at temperatures where their crystallizing power is great enough to overcome the resistance to viscosity. The higher the temperature the greater will be the tendency to crystallize provided the temperature is below that at which the crystals dissolve in the melt. The compound or compounds crystallizing under these conditions could be foretold if the melting point diagram of the system to which the glass in question belongs were known. For the soda-lime-silica glasses data are available on the two component systems CaO-SiO_2[2] and Na_2SiO_3-SiO_2[3] which give some information on the course of devitrification. Only that portion of the lime-silica system lying between the compound calcium metasilicate ($CaO.SiO_2$) and silica is of interest in its application to glasses, while in the sodium metasilicate-silica system the portion of interest to the glass technologist lies between the compound sodium disilicate ($Na_2O.2SiO_2$) and silica.

Figure 1 shows that portion of the ternary system Na_2O-CaO-SiO_2 lying between the points SiO_2 100%, Na_2O 50%-SiO_2 50%, and CaO 50%-SiO_2 50%. As in the usual triangular diagram, any point in the triangle represents a definite composition. Temperature relations cannot be represented graphically on a two dimensional diagram except by contour lines, as altitudes are indicated in topographic maps, but in a three dimensional diagram they can be represented by curved surfaces. The melting points and eutectic points for the portions of the binary systems CaO-SiO_2 and Na_2O-SiO_2 shown in the diagram are definitely established. The boundary lines AB and CD within the triangle are hypothetical and have been derived through a knowledge of the devitrification products of different types of soda-lime glasses.

In any two component system a eutectic point (a binary eutectic) is the lowest point on the melting curve between two adjacent compounds and it represents the point in composition where the two compounds crystallize simultaneously. In a three component system a boundary line delimits the fields of two contiguous compounds. Along this line the two compounds crystallize simultaneously. A ternary eutectic represents the meeting point of the boundary lines between three contiguous compounds and it is the point at which the three crystallize simultaneously.[4]

Boundary lines in ternary systems intersect the binary systems, represented by the sides of the triangle, at binary eutectic points. Although the binary eutectic is the lowest melting point between the two contiguous binary compounds, it is the highest melting point along the ternary boundary line which intersects the binary system at that point. In the diagram (Fig. 1), therefore, the temperatures may be expected to decrease along the boundary line AB between silica and calcium metasilicate as it leaves the binary eutectic point (A) and enters the triangle, that is, as it enters the system in which soda is present. The temperatures also decrease along the boundary line CD leaving the eutectic point between silica and sodium disilicate and entering the triangle. It is impossible to describe accurately the direction of the boundary lines within the triangle or the rate of temperature fall along the boundary line without exact experimental data, but the general course can be indicated.

Crystals produced by the devitrification of sheet and window glass are usually wollastonite ($CaO.SiO_2$). Wol-

[1]Published by permission of the Director of the Bureau of Standards of the U. S. Department of Commerce.

[2]Day, Shepherd and Wright, *American Journal of Science* (4) *22*, 265 (1906).

[3]Morey and Bowen, *Jour. Physical Chemistry*, *28*, 1167-79 (1924).

[4]Considerable information concerning the interpretation of equilibrium diagrams is contained in a paper by G. A. Rankin and F. E. Wright, "The Ternary System CaO-Al_2O_3-SiO_2," *American Journal of Science* (4) *39*, 1-79, 1915.

lastonite is probably then the primary phase[3] in the portion of the triangle where the compositions of sheet glasses occur and the boundary curve AB must be so placed that the point 2, which represents the composition of a typical window glass, lies within the field where wollastonite is the primary phase.

Devitrification in soda-lime bottle glasses always produces crystals of cristobalite or tridymite, the high temperature forms of silica, except where there is marked inhomogeneity

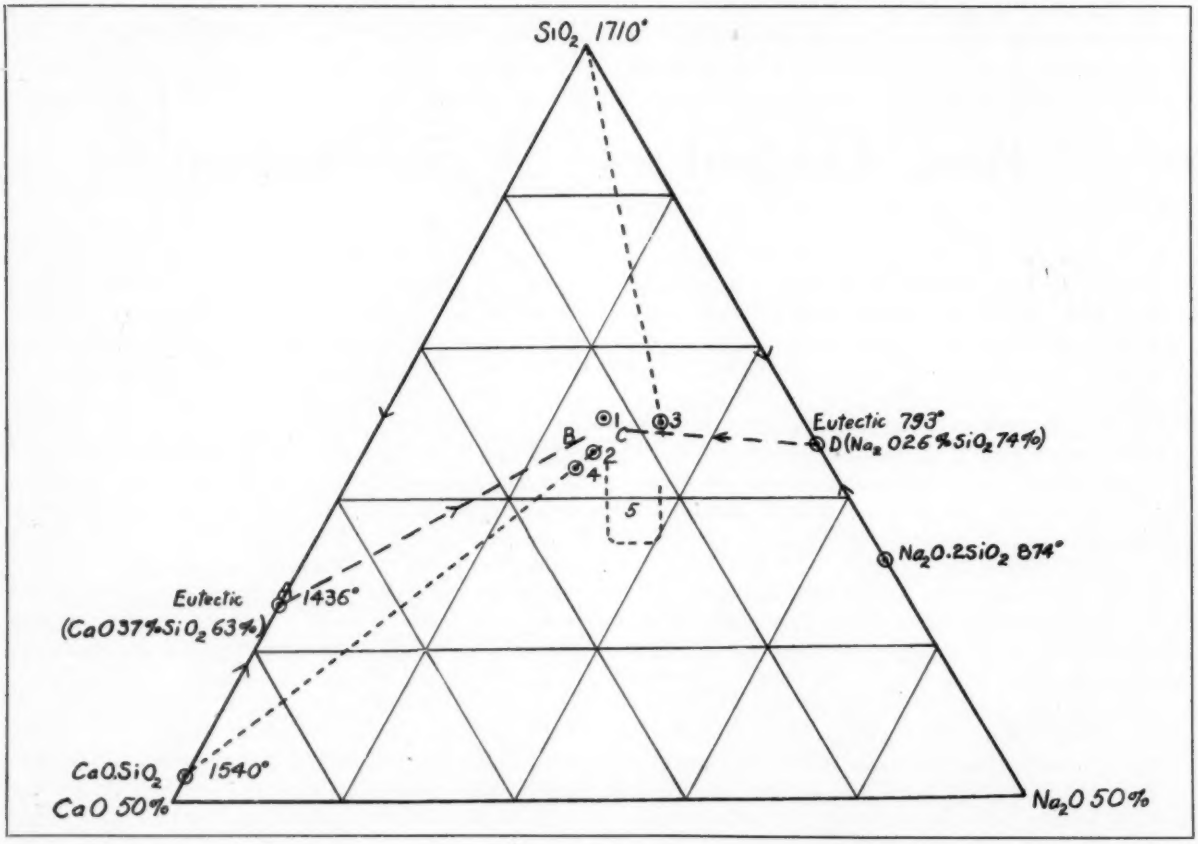


FIG 1

in the glass. A typical bottle glass contains SiO_2 75%, CaO 8.5%, Na_2O 16.5%, and is represented in the diagram by point 3. The boundary curve must lie so that point 3 is within the field where silica is the primary phase.

Certain plate glasses which apparently are high in both soda and lime produce crystals of a sodium calcium silicate, the exact composition of which is not known. The field wherein this compound is the primary phase cannot be definitely located, but its general position is indicated in the diagram.

The course of crystallization in such a system may be shown by considering a melt of the composition represented by the point 3. During the cooling of the melt under equilibrium conditions crystallization takes place at some temperature with the separation of cristobalite, tridymite or quartz since point 3 is within the field where some form of silica is the primary phase. As the temperature falls silica continues to crystallize and the composition of the melt changes along the extension of the straight line from SiO_2 through the point 3 until it reaches the boundary curve. At the boundary curve silica and the compound which is the primary phase on the other side of the boundary crystallize simultaneously and the composition of the melt changes along the boundary curve in the direction of the arrow. Crystallization of two compounds continues until the melt is used up or until the ternary eutectic point is reached where the simultaneous crystallization of three compounds occurs.

If the original melt had the composition of point 2 crystallization would begin with the separation of wollastonite crystals, the composition of the melt changing along the extension of the straight line from $CaO.SiO_2$ through the point 2 accompanied by falling temperature. Crystallization of wollastonite would continue until a boundary line or ternary eutectic point was reached.

These examples represent the course of crystallization in a melt where perfect equilibrium is attained. The production of good glasses depends upon the prevention of equilibrium conditions and even when devitrification occurs equilibrium is usually only attained during a small part of the cooling process.

Benrath supposed that a glass of the molecular composition $Na_2O.CaO.6SiO_2$, represented by point 1, was the most stable type. It is possible that the ternary eutectic is located near this point.

[3] A primary phase in a system of this kind is the first solid (crystalline) compound to separate when the temperature of a homogeneous melt is lowered.

If a ternary eutectic point lies near the region of the commercial soda-lime glasses, as seems probable, it cannot be much lower in temperature than the binary eutectic of silica and sodium disilicate (793°C.) since most glasses begin devitrification at or above this temperature. It must lie well below the melting temperature of pure silica (1710°C.) and the temperature of the eutectic between calcium metasilicate and silica (1436°C.). There must consequently be a rapid fall in melting temperatures of compositions on a straight line from calcium metasilicate to the ternary eutectic, on a straight line from silica to the ternary eutectic and on the boundary line from the eutectic calcium metasilicate-silica to the ternary eutectic while the fall in melting temperature of compositions on the boundary line from the eutectic sodium-disilicate-silica to the ternary eutectic must be fairly slow.

The practical usefulness of a diagram of this type can be shown by a few illustrations. If, for example, a window glass having the composition SiO_2 73%, CaO 13.5% and Na_2O 13.5% (point 2) devitrifies with the separation of wollastonite crystals ($CaO.SiO_2$), it is possible to predict how devitrification may be overcome. It can, of course, usually be prevented by raising the temperature in that stage of the glass-making process where crystallization is first observed. If that is not convenient or possible, the diagram indicates that crystallization may be avoided by increasing slightly the percentage of silica or of silica and soda in the batch since then the temperature at which crystallization begins will be lowered. At this lower temperature the viscosity of the glass will probably be greater and devitrification will be lessened or prevented. Whether devitrification should be prevented by raising the temperature or changing the batch composition will depend upon the viscosity required in working the glass.

If, in a bottle glass containing SiO_2 75%, CaO 8.5%, and Na_2O 16.5% (point 3), devitrification occurs with the separation of crystals of tridymite or cristobalite, the temperature at which crystallization begins may be lowered by addition to the batch of small percentages of soda or lime or both.

In a bottle glass having a high silica content the possibility of devitrification will be increased by still further raising the silica content since then the temperature at which the primary phase crystallizes will be increased. In the same manner the possibility of devitrification in a high lime sheet glass will be increased by increasing the lime content.

The temperature at which the primary phase begins to crystallize may be lowered by the addition in small amounts of other constituents, such as Al_2O_3. If the amount added is too great, however, the composition of the glass may be thrown into the field of another primary phase which will crystallize at a higher temperature.

When complete and accurate data on the system Na_2O-CaO-SiO_2 are available, the manufacturer of the soda-lime glasses will be able to reduce if not entirely eliminate devitrification through changing by a predetermined amount the batch composition or temperature.[6]

[6]Since the preparation of this paper, the writer's attention has been called to a paper by Morey and Bowen on "The Ternary System Sodium Metasilicate-Calcium Metasilicate-Silica" in the September, 1925, number of the *Journal of the Society of Glass Technology*, pp. 226-262. The boundary lines in the writer's diagram agree well with those in the ternary diagram as plotted by Morey and Bowen, but it should be noted that the point given here as a eutectic point (near B and C) is in reality a dissociation (quintuple) point. The principles to be used in preventing devitrification as given in this paper are not affected by the more exact experimental data of Morey and Bowen. With the aid of the diagrams given by them, the glass technologist may determine quantitatively the necessary changes in batch composition or temperature.

A Problem

A glass company has a supply of cullet on hand of the following composition:

SiO_2	74.50%
Al_2O_3 and $Fe2O_3$	2.00%
CaO	4.60%
MgO	3.15%
Na_2O	15.90%

The glass desired is of the composition:

SiO_2	75.63%
Al_2O_3 and Fe_2O_3	3.35%
CaO	2.30%
MgO	1.55%
Na_2O	17.30%

It is desired to use a fill of 50 per cent cullet and 50 per cent batch. Make up the best possible batch of sand, soda ash, limestone, feldspar, so that the resulting glass in the tank will approximate as closely as possible to the glass that is wanted. (Use any amount of each of these four ingredients.) Give answer based on 1,000 pounds of sand.

ANALYSES OF RAW MATERIALS ON HAND

Material	SiO_2	R_2O_3	CaO	MgO	Na_2O	Ign. Loss
Feldspar	70.8	17.30	.....	..	12.00	.40
Sand	99.6	.....	.....	..	.....	.40
Limestone	....	.....	30.22	22	.....	47.64
Soda Ash	....	.....	.....	..	57.50	42.00

NOTE.—The feldspar will run partly K_2O but its Na_2O equivalent is 12.00% as given.

Solution

Let x equal the shrinkage in weight of 1,000 pounds of the batch during melting.

Let y equal the number of pounds of sand used in making 1,000 pounds batch.

Let z equal the number of pounds of soda used in making 1,000 pounds batch.

Let k equal the number of pounds feldspar used in making 1,000 pounds batch.

Now (1,000 — x) will equal the number of pounds of glass made from 1,000 pounds of the batch.

1,000 plus (1,000 — x) will equal the number of pounds of glass made from 1,000 pounds of the cullet and 1,000 pounds of the batch. We will write this (2,000 — x).

We will now write the following five equations:

(1) .4% y + 42% z + .4% k = x.

(2) y + z + k = 1,000.

(3) 745 + 99.6% y + 70.8% k = 75.63% (2,000 — x).

(4) 20 + 17.30% k = 3.35% (2,000 — x).

(5) 159 + 57.5% z + 12% k = 17.3% (2,000 — x).

We have five equations and four unknowns. These are easily solved and we obtain:

x.....	104.	
y.....	506.5	or 1,000 pounds of sand.
z.....	241.5	478 pounds of soda ash.
k.....	252	491 pounds of feldspar.

The batch will be without limestone since it is easy to see that there is sufficient in the cullet to give the desired quantity in the glass.

Continuous Batch Feeder in Successful Operation on Window Glass Tank

The use of mechanical batch feeders for continuous glass tanks was advocated in the article by D. J. McSwiney entitled "The Thermal Efficiency of Glass Melting" in the July, 1925, issue of THE GLASS INDUSTRY and reasons given why such a method of feeding should increase the melting efficiency.

Such a device has been in use for several years at the St. Louis plant of the Mississippi Glass Company where it was introduced by George Aurien, superintendent of the plant.

The melting results attained at this plant are quite remarkable, and these results are attributed largely to this method of batch feeding.

The batch used at this plant gives a glass which is hard even for a window glass; that is to say, it is harder than any glass used on window glass machines, and is very much harder than any glass a bottle manufacturer would think of trying to melt. Yet, the pull maintained on this tank is about fifty per cent greater per unit of melting surface than the average pull on bottle tanks in this country using a very much softer glass and operating at a temperature at or near that at which this tank is operated.

As is usually the case in flat glass, limestone is used as the source of lime. Unlike most window glass plants, the cullet is delivered to the furnace mixed with the batch. The amount of cullet used is no greater than that ordinarily used in window glass tanks. The scum formation on this tank is much less than is usual on tanks melting a batch of this nature and melting a much smaller tonnage.

Despite the heavy pull carried, the average life of the tanks at this plant is as long as that of tanks of similar construction, melting a batch of similar composition, and on which the pull is only half as great.

An interesting feature of this feeding device is its simplicity; it can be readily used with little or no change in any plant having a batch bin located above the filling end of the furnace.

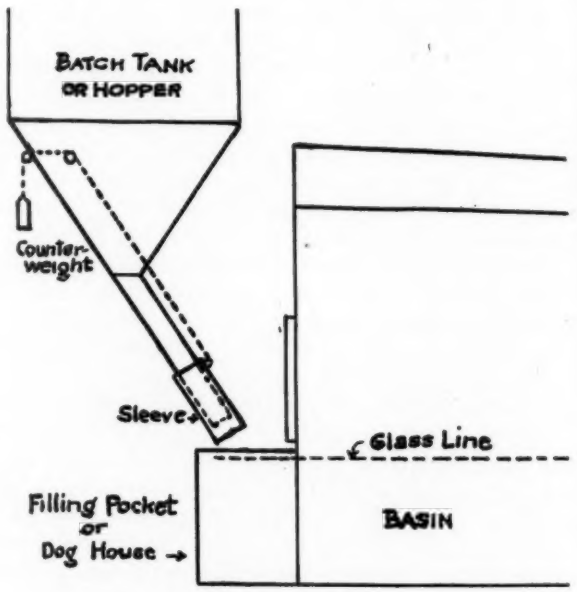
The feeding device consists of a six-inch steel pipe leading from the batch bin at an angle of 60 degrees to the dog-house, through which the batch and cullet mixture is fed by gravity. At the bottom of the pipe is a sleeve about two feet long which can be raised or lowered according to the amount of batch required to take the place of the glass drawn from the working end of the tank. The rate of flow of the batch to the glass level is determined by the height of the sleeve opening above that level. This distance is regulated by means of the chain attached to the top of the sleeve and controlled by the counterweight, as shown in the diagram.

With very little practice the tank man can easily learn the best adjustment of the sleeve for a heavy or light pull and can raise or lower the sleeve accordingly.

This feeding device differs from other mechanical batch feeders proposed in that the batch is not pushed into the tank, but instead, is drawn in through the pull of the glass from the working end of the tank. The only hand labor required is to (occasionally) have a man pile a little batch against the mantle block to seal the opening at this point.

The dog-house is of a size which is often used in window glass houses but is almost double the length of that ordinarily used on bottle tanks. Only one dog-house is used and this in the center of the tank.

As the tank is about twenty feet wide, it would appear that this method of feeding would cause the batch to be drawn into the tank in diverging lines from the dog-house, and that the corners of the tank would always be clear of batch



and would thus contribute nothing to the melting surface of the tank. As a matter of fact, however, an examination of the rear of the tank shows it to be much more completely utilized than is the case with hand-filled tanks, the entire rear of the tank, even the corners, being covered with piles of batch. The individual piles are very small and close together, so that there is very little of the surface of this portion of the tank which is not contributing at all times to the melting and refining of the batch. All the batch filled lies close to the surface so that the melting and refining takes place at the point where it can be effected most efficiently.

New Thermometer Measures 1800 Degrees

Dr. E. R. Berry, assistant director of the Thomson Research Laboratory of the General Electric Company, who has specialized for years in research work with clear fused quartz and who was recently awarded the Grasselli Medal from the American Section of the Society of Chemical Industry, took advantage of the occasion to announce the development of a new thermometer to record temperatures up to 1,800 degrees. The fused quartz thermometer tube contains gallium, a rare metal never before commercialized.

Natural Gas as Fuel in Glass Furnace Stack

By J. P. Schellhaus, Jr.,* and George J. O'Neill†

Last July a twelve pot glass furnace stack at the Maryland Glass Company, Cumberland, Maryland, was converted from coal to gas and has given very satisfactory results, fulfilling expectations of the gas company's engineers and of the glass company's management. The stack has been used continuously during the last forty-four years, with the exception of two years idleness, due to a fire which destroyed the plant.

Natural gas was used in the stack previous to 1917. From that time until the present, coal has been used as a fuel.

On the morning of July 22, 1925, at 10 A.M., the first heat was applied from four 1¼ inch pipes flattened at the ends, located in the eye of the furnace. Plain gas was burned at the rate of 780 cubic feet per hour. There were twelve new pots in the furnace, and great care had to be exercised not to crack the pots by raising the temperature too rapidly. On the morning of July 25th the gas consumption was increased to 900 cubic feet per hour. At that time the furnace temperature was 300 degrees Fahrenheit.

The temperature of the furnace was then raised as follows:

			Fahr.	
July 26	10 a.m.	900 cu. ft. hr. cons.	400°	Atmospheric Burners
" 27	10 "	1380 " " " "	650°	
" 28	10 "	1800 " " " "	1000°	
" 29	10 "	2250 " " " "	1400°	
" 30	10 "	3300 " " " "	1650°	
" 31	(2000° at noon) Cut down consumption, furnace temperature rising too quickly.			
" 31	3 p.m.	3120 cu. ft. hr. cons.	1840°	
Aug. 1	1:30 "	3000 " " " "	2020°	
" 1	2:15 "	Blast burner started Atm. burners removed		
" 1	2:45 "	3600 cu. ft. hr. cons.	2000°	
" 1	4 "	4200 " " " "	2080°	
" 2	10:30 a.m.	4200 " " " "	2180°	
" 3	11:30 "	4800 " " " "	2220°	
" 4	11:00 "	4500 " " " "	2300°	

Glass blowing was started on the morning of August 5th, at 7 A.M.; the first melt had been brought in in thirty-four hours on a gas consumption of 4,500 cubic feet per hour or 153,000 cubic feet for the melt. There was one ton of glass in each pot or 26,400 pounds of glass melted. The volume of gas required to melt one pound of glass amounted to

$$\frac{153.000}{26.400} = 5.8 \text{ cubic feet.}$$

The furnace measures twenty-two feet inside diameter, seven feet from the top of the eye to the crown. The eye is five feet in diameter by four feet deep. The temperature is indicated by a Brown temperature indicator. The thermocouple is placed between two pots near their tops. The pots were purchased from the Gill Clay Pot Company of Muncie, Indiana and weigh approximately 2,250 pounds each. The gas is supplied to the furnace through a No. 6 Maxon-Premix blower, which has a 2½ inch gas inlet and a 6-inch gas-air mixture outlet. It is provided with a 6-inch cast iron "sticktite" nozzle. The top of the nozzle is about two feet from the top of the furnace eye. The blower is located in the old cave under the stack which was used for removing the ashes from the coal fire.

The furnace was formerly coal fired, through a tease hole between two pots.

Besides using gas in the large stack this company also employs gas as a fuel for seven annealing lehrs, one large and one small glory hole, two glazing machines, eight cutting off burners, one large continuous decorating lehr, three standard decorating kilns, and four wax pots.

An automatic gas cut-off valve of the magnet type is installed in the supply line to the Premix machine, which automatically cuts off the gas when the current to the motor fails.

ARCHWAY UNDER FURNACE
Showing blower, main, spare and emergency burners and automatic gas cut-off valve

This safeguards against explosion, which may be caused either by a large volume of unconsumed gas in the furnace, or by the escape of gas through the air shutter of the Premix machine into the archway under the furnace. This valve is a gate type with weighted lever arm, held in raised or open position by the magnet. When the current fails the weight drops and by means of a light chain to a switch overhead, the switch is pulled into contact and a bell is rung outside of the plant, giving notice that the valve has functioned. The bell circuit is operated by dry cells.

The plant is supplied with gas from a 4-inch line at five pounds pressure to a 4-inch governor and a 4-inch Wylie proportional meter. The feed line into the furnace is four

* Maryland Glass Company.
† Cumberland and Allegheny Gas Company.

inches, reduced to three inches at the automatic cut-off valve, placed three feet from the inlet of the machine, which is 2½ inches in diameter.

There are no obstructions, such as valves or air gates in the outlet of the machine to the burner nozzle. About twenty feet of 6-inch pipe is run straight from the blower outlet to a 6-inch extra heavy cast iron elbow, then about six feet of 6-inch pipe run vertically into the eye of the furnace to a 6-inch nozzle. This nozzle has a 3½ inch outlet. Midway of the twenty-foot run of 6-inch pipe a companion flange is located for the purpose of renewing the burner in the quickest possible time. An extra burner is carried in stock. From the 4-inch line to the blower two 2-inch connections, each

FURNACE WORKING FLOOR

provided with a valve, are made for two emergency burners. These consist of a length of 2-inch pipe with two 1¼ inch verticals flattened at the outlet. They are used in case the blower fails, when installing the large main burner, or during any other necessary changes.

Under present working conditions an average of forty pots of glass is melted per week, or 5.7 pots melted per day. As many as forty-five pots per week have been obtained.

It requires nineteen hours to melt a charge, and twenty-three hours, from charging to working condition. The glass is permitted four hours stand-off after the pot is opened before working the glass.

Then 40 pots melted per week × 2,200 pounds = 88,000 pounds glass melted per week. 4,500 cubic feet gas per hour × 24 hours = 108,000 cubic feet gas per day. 5.7 pots per day equal 12,540 pounds glass melted per day, average. Then $\frac{108,000}{12,540} = 8.6$ cubic feet of gas per pound of glass melted.

The natural gas as served shows by test 0.65 specific gravity and in excess of 1,100 B.t.u. per cubic foot.

The company endeavors to maintain an average furnace temperature of 2,350 degrees Fahrenheit. Since the glass must be heated by means of conduction of the heat through the heavy walls of the pots, there must also be considered the heat required to heat and maintain the temperature in the 27,000 pound of clay of the twelve pots, the heating of the furnace walls and crown roof and the loss by radiation.

The furnace was primarily designed to burn coal. Gas was installed in such a way that coal can readily be reverted to should the gas supply fail through breaks in the long transmission lines by landslides, washouts, etc. Considering these facts it may be stated that very fair results are being obtained. Since gas has been installed the company has increased its output considerably. This can be accounted for by the even temperature maintained, resulting in decreased losses by the blowers, less loss in the annealing lehrs and during the finishing process.

The Maryland Glass Company manufactures lead glass tableware, stemware, tumblers, vases and novelties in both crystal and colors. They do their own finishing, decorating and cutting.

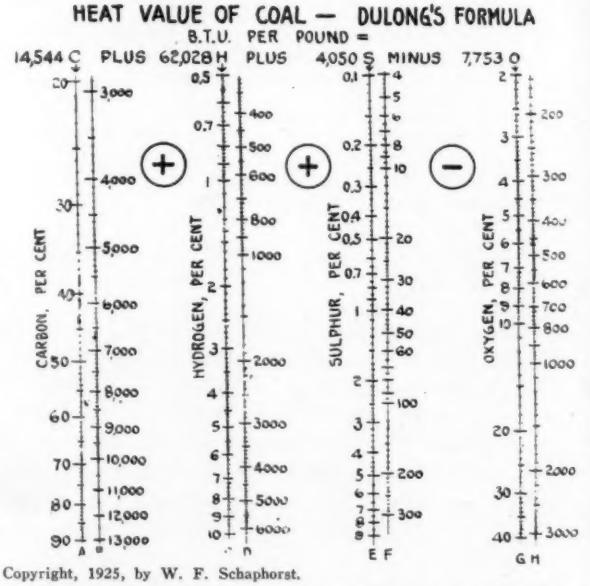
The average life of the pots was eight to ten months when coal was used as a fuel. The coal fire was pulled each summer to repair the furnace eye.

At Lonaconing, Maryland, the Utility Glass Works have used gas for the past five and a half years for all their heating requirements. The twelve pot stack there has been in continuous service over that period of time and although in need of repair now, it will be operated at least until next summer. The life of their pots ranges from twelve to seventeen months. When gas is used there is considerable saving in labor charges, since the service of at least two firemen is released and storage space reduced.

Heat Value of Coal—Dulong's Formula Simplified

By W. F. Schaphorst*

Here is a chart that makes it easy to compute the heat value of any coal, knowing the percentages of carbon, hydrogen, sulphur and oxygen. With this chart it is not


HEAT VALUE OF COAL — DULONG'S FORMULA
B.T.U. PER POUND =
14,544 C PLUS 62,028 H PLUS 4,050 S MINUS 7,753 O
CARBON, PER CENT
HYDROGEN, PER CENT
SULPHUR, PER CENT
OXYGEN, PER CENT
A B C D E F G H

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necessary to do any vexatious multiplying or dividing at all. Simply add three figures and subtract one figure and the result is the number of B.t.u.'s per pound. Adding and subtracting are always easier for most of us than dividing and multiplying.

For example, selecting at random from a long list of coal

* Mechanical Engineer.

samples the writer has taken one called Marianna mined near Pittsburgh. Its analysis shows 78.76 per cent carbon, 5.23 per cent hydrogen, 0.78 per cent sulphur and 7.61 per cent oxygen.

To apply the chart find the 78.76 per cent carbon in column A at the extreme left. Opposite this in column B will be found 11,300. Write 11,300 on a slip of paper.

Then find 5.23 per cent carbon in column C and in column D the corresponding number is 3,250 which is to be added to the 11,300.

Then find 0.78 per cent sulphur in column E and column F shows the corresponding number to be 31.

Adding we get:

11,300
3,250
31

14.581

Now find 7.61 per cent oxygen in column G. The corresponding number in column H is about 595.

Subtracting 595 from 14,581 we get 13,986 as the heat value of the coal in B.t.u.

This chart is based on Dulong's well known formula which is said to give results that are accurate within one and one-half per cent for most coals that are dry. The formula as usually written is:

$$\text{B.t.u. per lb.} = 14{,}544C + 62{,}028\,[H - (O/8)] + 4{,}050S$$

As will be observed I have slightly altered the formula for the purpose of making this chart. The alteration is written out above the chart shown on the opposite page in this way:

$$\text{B.t.u. per lb.} = 14{,}544C + 62{,}028H + 4{,}050S - 7{,}753\,O$$

Observe, too, that arrows point from the symbols C. H, S, and O, at the corresponding columns so that no mistake can be made. Also within the circles between the columns the signs plus and minus are shown prominently to aid the user in making rapid computations and to prevent possibility of error.

Progress in Glass Etching*

A Detailed Description of Modern Etching Processes

During recent years important innovations have occurred in the field of glass etching, so that it is of interest to consider those advances. The oldest way to produce glass etchings is by means of hydrofluoric acid. Many methods which today are being published as new have been described in great detail many years ago. For instance in the past hydrofluoric acid was used to render old sheet glass transparent again, according to a process of the glass manufacturer Gresly. A new German patent took up this old process and recommends dipping old, untransparent glass in dilute hydrofluoric acid and to wash it with water.

Etching with hydrofluoric acid is used especially to produce matt designs on glass. By using a mixture of fluorspar and concentrated sulphuric acid it is possible to obtain etchings of a depth of two millimeters, if repeated often enough. Not only heavy outlines but the finest drawings, engraved on a layer of wax can be etched in this way.

Napier's process, by which designs in relief are obtained with hydrofluoric acid, is as follows: A drawing is made on paper using printer's black. This paper is pasted on the glass surface with starch paste. After complete drying, hydrofluoric acid (specific gravity 1.14) is poured on the glass and is allowed to act for about three minutes. The paper and the glass surface below is attacked by the acid with the exception of the parts covered with printer's black. The latter then appear in relief.

Another process which gives drawings or writing in relief on glass and porcelain is as follows: The design is made on the glass with varnish as a pigment. While still wet, metallic or copal powder is dusted on the design. The glass object is then dipped in hydrofluoric acid and subsequently washed with water. This powder, which prevents the attack of the hydrofluoric acid for some time causes the design to appear in relief and as a matt etching, since the thin layer of varnish does not prevent the matt etching of the glass.

If alkali fluoride salts are used for glass etching the heating must be done in such a way that opaque etchings are the result. If it is not desirable to heat to such a high temperature, a lower temperature will do provided that the glass be exposed to vapors of sulphuric acid and water. However, the etchings obtained in this way are less matt. Fluorides of ammonia and the alkaline earths give less satisfactory results.

The etching of hollow glassware forms a chapter by itself. Either the whole surface of the glass can be etched or etchings in relief or depressed can be obtained. The glass is first thoroughly cleaned from any adhering grease and is then transferred to the matt etching bath. This is made up of hydrofluoric acid to which twenty times its volume of water is added, neutralized with 90 per cent potash solution. For every part by weight of hydrofluoric acid one-half part of concentrated acid is added. After 20 to 30 minutes the etched glass is washed with hot water. By subsequently dipping the glass in hydrofluoric acid diluted with five times its volume of water, a silky finish is obtained. A bath of 1,000 parts of water, 250 parts of acid potassium fluoride, 250 parts of hydrochloric acid and 140 parts of potassium sulphate is used frequently. Instead of potassium sulphate, potassium oxalate or zinc chloride is sometimes used. The latter substance gives deep matt etchings of great perfection.

By using hydrofluoric acid of varying strengths special effects can be obtained. Transparent etchings can be ob-

*From *Allgemeine Glas-und Keram-Industrie*, Vol. 16, No. 5. Translated for the GLASS INDUSTRY.

tained by using dilute hydrofluoric acid, since this removes the surface evenly. By mechanical removal of the salts the action is improved. Strong hydrofluoric acid gives etchings resembling ice. This can be explained when it is considered that salts formed are less soluble in strong acid and therefore remain attached to the glass. They are detached irregularly so that the glass appears rough and uneven. This method can be used for the manufacture of decorated glassware. The glass is dipped in a hydrofluoric acid-sulphuric acid bath of definite concentration. The gas bubbles cause the formation of transparent lines which appear in relief. The glass surface may be dotted with varnish or wax. The glass is then dipped in hydrofluoric acid, diluted with one and a half or twice its volume of water. This causes the formation of fluorine salts at the dotted spots where they connect in the form of stars or snowflakes. They protect the glass against the action of hydrofluoric acid, while the rest of the glass surface is etched. After washing, the stars appear in relief on the glass surface. Especially potash-lime and potash-lead glasses are suited for this process.

The etching of designs on glass by means of hydrofluoric acid can also be done by using lace soaked in grease. The lace is pressed onto the glass surface and is subsequently removed. The glass is then exposed to fumes of hydrofluoric acid. After four or five minutes a matt surface is obtained covered with a network of transparent lines.

To make graduated scales for laboratory apparatus the glass is first heated and covered with beeswax. The scale division is then made and the glass dipped in hydrofluoric acid. The excess of acid is washed off, the wax is removed and the scale divisions covered with a mixture of red lead and shellac. This fills up the etched lines with red color and makes them clearly visible.

The preparation of resists for sandblasting and etching with hydrofluoric acid is very important. A good resist for sandblasting which is attacked only slightly by the sand is made by heating 50 grams of moistened gelatin with 50 cubic centimeters of zinc chloride solution of 25° Beaume and 250 grams of lampblack. The viscous, rubber-like mass is transferred to the glass, using stencils. A brush cannot be used since the material is too thick and viscous. For this reason a spatula is preferred. The covered parts are sprinkled with tallow and allowed to harden a few hours. The sandblast is then turned on and after the matt has been obtained the resist is washed off with cold water.

In order to prepare a resistant covering for glass decoration, a design is made on lithographic stone. The design is printed on paper using an ink made of rubber solution, varnish and lampblack. Calcium sulphate powder is sifted on the ink after the printing. Then a second impression is made on the same paper with another ink consisting of varnish, asphalt, chrome yellow and wax. The design is transferred from the paper to the glass, calcium sulphate is applied and the glass is sandblasted with a fine stream of sand. If a deeper design is desired, the glass plate is first covered with varnish. The drawing is transferred from the paper to the glass as above with the first ink. One or more impressions are made with the second ink. The varnish not covered by the design is removed with alcohol. The resist can now be used, either with the sandblast or with hydrofluoric acid.

To expose the white glass of colored cased glass the sandblast may be applied. A resist is made of ten parts of linseed oil, one part of oil of turpentine, two parts of amber varnish and enough powdered tallow until a plastic mass is formed. The preparation of the resist is very important if enameled and gilt inscriptions or decorations are desired on polished glass. The resist must protect the surface against the acid or the sandblast. Such a resistant material can be made of thirty parts of wax, resin and rubber, dissolved in oil of turpentine, one hundred parts of turpentine, forty parts of varnish, twenty-five parts of colophonium, six hundred parts of asphalt and sixty parts of tallow.

If it is desired to make matt designs on glass, the objects are first dipped into a bath of hydrofluoric acid, ammonium sulphate and ammonium carbonate. The object is then covered with the resist. The open spaces are treated with the sandblast. After removal of the resist the design becomes visible in contrast with the rest of the surface.

If it is desired to etch window glass, the pane of glass is laid horizontally and is covered with fine wet sand. The glass is then rubbed with a piece of marble until the surface has become matt.

To obtain a matt on electric light bulbs the glass is dipped for a short time in five per cent hydrofluoric acid until a sufficiently deep matt is formed. Cheaper glassware is treated with the sandblast. The walls must be strong enough to resist the pressure of the sandblast.

Etching ink may be made as follows: In a porcelain mortar equal amounts of acid ammonium fluoride (NH_4HF_2) and dry precipitated barium sulphate are mixed. The mixture is transferred to a lead or rubber container and moistened with fuming hydrofluoric acid. A thin rubber rod is used for stirring. With this mixture it is possible to write on glass, using a steel pen. In about fifteen seconds good etchings are obtained. The liquid can be kept in rubber bottles, closed with a cork stopper which has been dipped in wax. The liquid must be mixed well before use.

Another etching ink is made by mixing one part of ammonium fluoride, 3 parts of barium sulphate and enough sulphuric acid to form a thin paste. An etching ink which will keep indefinitely is made using the following solutions:

SOLUTION I		SOLUTION II	
Water	500 parts	Water	500 parts
Sodium fluoride	30 "	Zinc chloride	14 "
Potassium sulphate	7 "	Hydrochloric acid (conc.)	56 "

Mix equal volumes of solutions I and II in a lead vessel. The writing may be done with a steel pen or a goose quill. Instead of a lead vessel, a porcelain or glass container may be used, coated with paraffin. The coating may be obtained by pouring molten paraffin in the heated container and by moving the latter around, until the surface is completely covered. The excess is poured out and the covering is allowed to harden.

The stock solutions may be kept in bottles, as they do not attack glass until combined. They keep their strength indefinitely.

The Laboratory

The Valuation of Manganese

The quantitative chemical analysis of manganese dioxide, generally called manganese by the glassmaker, is one of the important tasks of the glass chemist. Since the material is used as found in nature, it is often impure and may contain considerable amounts of iron. Many a glassmaker has used manganese as a decolorizer only to find the remedy to be more deadly than the disease. While the determination of iron is of great value in the valuation of manganese used as a decolorizer, it is of little interest to the glassmaker who wishes to use the material to produce green bottle glass, since in that case iron oxide is often purposely added to the batch. Accurate knowledge of the amount of manganese is of interest in all cases.

The majority of methods for the analysis of manganese do not give the total amount of metallic manganese but

FIG. 1. APPARATUS FOR RAPID FILTRATION ON ASBESTOS.
P Perforated Porcelain Disc.

only that present as the dioxide, MnO_2. Several of the methods developed for the estimation of manganese are based on the oxidizing power of MnO_2. The figure thus obtained is often too low as manganese may also be present in forms which do not yield oxygen. A simple, rapid and accurate method of determining total manganese is valuable to the glass chemist. Such a method has been devised by Blair[1].

Originally proposed by Schneider[2], it was used primarily for small amounts of manganese, until it was found that with some precautions it is also applicable to large amounts of manganese.

The procedure is based on the fact that a manganese salt in nitric acid solution is completely oxidized to permanganic acid by sodium bismuthate. The permanganic acid is reduced by ferrous ammonium sulphate in excess, which is titrated back with N/10 permanganate solution.

The precautions to be observed to assure stability of the permanganic acid are:

1. The nitric acid should have a specific gravity of 1.135 (3 parts of water mixed with 1 part HNO_3).
2. The solution should be cold, from 10 to 15 degrees C.
3. Chlorides must be absent. Traces of hydrochloric acid vitiate the results.

PROCEDURE

One half gram of the dried and finely powdered material is dissolved in 50 cc. hot nitric acid (sp. gr. 1.135) to which 10-15 cc. hydrogen peroxide is slowly added. Heat till solution is complete. Filter into an Erlenmeyer flask and wash with nitric acid,[3] add to the filtrate 3 grams of sodium bismuthate to insure oxidation of organic matter and to decompose any remaining hydrogen peroxide. Heat to boiling, add a few drops of sulphurous acid to discharge the color and boil off the excess. Add sufficient nitric acid (sp. gr. 1.135) to bring the volume to 250 cc. and cool by immersion of the flask in cold water.

Add 8 grams of sodium bismuthate and agitate the solution vigorously. Then add 250 cc. of water and filter at once with suction on an asbestos filter, supported on a perforated porcelain plate, resting on a glass funnel. Wash with 3 per cent nitric acid until colorless.

The solution is transferred to a large beaker, containing nine grams of dry ferrous ammonium sulphate, accurately weighed. The color due to permanganic acid is discharged immediately and the clear solution is titrated with N/10 $KMnO_4$.

Calculation:

a = weight of the sample of manganese.
b = weight of ferrous ammonium sulphate.
c = number of cc. N/10 $KMnO_4$ equivalent to one gram of ferrous ammonium sulphate.
d = number of cc. N/10 $KMnO_4$ required for back titration.

Since 1 cc. N/10 $KMnO_4$ = .001099 Mn we have:

$$\% \text{ Mn} = \frac{(bc - d)\ .001099 \times 100}{a}$$

If a = 0.5; c = 9.0, the formula may be written:

$$\% \text{ Mn} = (9c - d)\ .2198.$$

The value of the ferrous ammonium sulphate in terms of N/10 permanganate solution is determined as follows:

Carefully mix the contents of a bottle of the pure salt and weigh out 5 grams. To 250 cc. nitric acid (sp. gr. 1.135) contained in an Erlenmeyer flask add 2 grams of sodium bismuthate and agitate. Dilute with 250 cc. of water, and filter on asbestos. Add 5 grams of ferrous ammonium sulphate and titrate with N/10 permanganate

[1] Chemical Analysis of Iron 7th Ed., 121-129.
[2] Dingler's Polyt. Journal, 269, 224.
[3] The residue is usually free from manganese. If great accuracy is required it may be treated with HF and a few drops of H_2SO_4 to volatilize the silica. The residue is then fused with $Na_2S_2O_7$, dissolved and added to the filtrate.

solution. The number of cc. divided by 5 gives the number of cc. of N/10 $KMnO_4$ equivalent to one gram of the salt. (Usually about 25 cc.).

If kept in a closed bottle, the salt remains unchanged for a long time.

DETERMINATION OF IRON

This procedure is based on the precipitation of iron with Baudisch's reagent, cupferron[4], $C_6H_5(NO)ONH_4$, amino nitrosophenyl hydroxylamine) and weighing as Fe_2O_3.

From 2 to 10 grams of the sample, according to the iron contents, are dissolved in hydrochloric acid and the solution boiled until chlorine is expelled. Dilute with water and filter. Ignite the residue, transfer to a platinum dish, add nitric and hydrofluoric acids. Evaporate on a hot plate to a small volume and add a few drops of sulphuric acid. Evaporate to fumes of SO_3, add water, boil, filter and add to the main solution.

To the solution which should be cool, add an excess of 6 per cent cupferron solution. This precipitates iron and titanium if present, but does not precipitate aluminum, manganese, nickel, cobalt, chromium, cadmium or zinc. Copper, if present, is precipitated with the iron but it may be removed by washing with ammonia.

Filter with suction, wash with 10 per cent hydrochloric acid, then with water followed by 10 per cent ammonia and finally with water. Ignite and weigh as Fe_2O_3.

If titanium is present, it may be determined by fusing the ignited precipitate with sodium bisulphate. The melt is dissolved in 10 per cent sulphuric acid and transferred to a Nessler tube. Hydrogen peroxide is added and the titanium determined by the colorimetric method using a standard solution of $TiSO_4$. The amount of TiO_2 found is deducted from the weight of the combined oxides, giving the weight of Fe_2O_3.

CALCULATION: $$\% \text{ Fe} = \frac{\text{Weight of } Fe_2O_3 \times .6994 \times 100}{\text{Weight of sample}}$$

If the manganese is used as a decolorizer, the iron content should not exceed 1 per cent. Special glasses may require manganese carrying less than 0.5 per cent iron.

DETERMINATION OF MnO_2

A volumetric method to determine manganese dioxide based on the reaction between MnO_2 and oxalic acid was described on page 270, volume 2 of this JOURNAL.

Some chemists prefer the ferrous sulphate method of Lunge[5] based on the following reaction: $MnO_2 + 2FeSO_4 + 2H_2SO_4 = Fe_2(SO_4)_3 + MnSO_4 + 2H_2O$. The excess of ferrous sulphate is titrated with N/2 permanganate.

PREPARATION OF THE FERROUS SULPHATE SOLUTION: To 500 cc. water add 200 cc. concentrated sulphuric acid, mix and to the hot solution add 100 grams of powdered ferrous sulphate. Dilute to one liter and titrate 75 cc. of the solution with N/2 permanganate.

PROCEDURE: Transfer 1.0866 grams of the dry and finely powdered sample to a 250 cc. Erlenmeyer flask containing about ½ gram of sodium bicarbonate. Add 75 cc. ferrous sulphate solution, and close the flask with a rubber stopper carrying a glass tube bent twice at right angles, the end of which dips into a cold saturated solution of sodium bicarbonate.

Heat the flask until the sample is dissolved and allow to cool. During the cooling process some of the bicarbonate solution is sucked back into the flask and generates carbon dioxide. In this way access of oxygen is prevented.

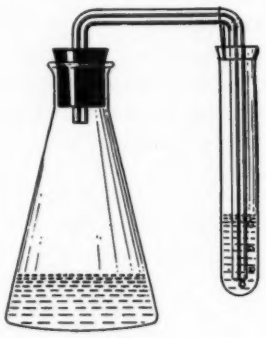

FIG. 2

When cool, remove the stopper and immediately titrate with N/2 permanganate.

CALCULATION:

a = number of cc N/2 $KMnO_4$ required by 75 cc. $FeSO_4$ solution.

b = number of cc. N/2 $KMnO_4$ required for back titration.

Since 1 cc. N/2 $KMnO_4$ = .02173 MnO_2 we have:

$$\% \text{ } MnO_2 = \frac{(a - b)\ .02173 \times 100}{1.0866} = 2\ (a - b)$$

[4] Chemiker Ztg., 33, 1298, 1905; 35, 913, 911.
[5] Chem.-techn. Untersuchungsmethoden. 1, 569.

Latest Applications of Pyrex Glass

BY W. H. CURTISS†

The most recent application of pyrex to a large commercial field is the introduction of pyrex insulators. The electrical engineer demands for the insulation of transmission lines a material that has great tensile strength, is impervious over a long period of years to extreme weather conditions and that likewise possesses the right dielectric properties. Corning has had a large measure of success in demonstrating to the electric industry that pyrex admirably meets all of these conditions and many thousands of pyrex transmission line insulators are now in service.

This development came at a time when the whole world was preoccupied by the marvelous possibilities of radio communication and it was only natural that pyrex as an insulating material should capture the interest of radio engineers. It was soon proven that pyrex had a remarkably low power loss factor and that for both sending and receiving better results could be obtained with pyrex insulated equipment. The navy, the coast guard, the air mail service and many large commercial stations have now adopted pyrex as the standard insulating material for all radio equipment. Radio insulators in a wide variety of size and form as well as sockets, tube bases, condenser parts and other radio specialties are now manufactured from pyrex in large quantities

† Corning Glass Works.

Plate Glass Manufacturers at Tariff Hearing

Men Opposed to Reduction in Import Duties Have Their Innings

A digest of the testimony presented by witnesses representing importers and foreign manufacturers of plate glass during the first two days' sessions, November 23 and 24, of the United States Tariff Commission's public hearing at Washington on production costs of cast polished plate glass and mirror plate was published in the December issue. The hearing, which had been adjourned from November 24, was resumed on November 30 and there follows here a heavily abridged report of the testimony given on that day by opponents of the applicants for lower import duties on plate and mirror glass. A report of the proceedings of Tuesday, December 1, when the final sessions of the hearing were held, will be given in the February issue.

Before closing the hearing, it was decided to set December 15 as the day on which briefs were to be submitted to the Commission by counsel summing up for each side. Later, however, the time was extended to December 21. The decision of the Commission as to making a new investigation covering new developments in plate glass manufacturing since 1923 probably will not be announced for some time, until the testimony obtained at the recent hearing is thoroughly digested by the members.

The taking of testimony on the morning of November 30 began as follows:

MR. GALLERT (representing the Association of Foreign Glass Producers): I understand that Mr. Francis D. Campau, representing the Furniture Association of Grand Rapids desires to make a statement.

MR. CAMPAU: We have no evidence to offer as to comparative costs of production in this and foreign countries, but if and when the Commission decides that there is such a difference in the manufacturing costs of plate glass abroad and here as warrants it taking some action we are directly interested in any readjustments of the tariff.

It has been suggested in the cross examination of Mr. Solomon that the cost of production of plate glass is the same per foot in large and small sizes; and it has also been suggested that some sacrifices of profits are made in the sale of the smaller sizes, which are made up in the prices on the larger sizes.

Just here the furniture industry interest begins. While we are users to some extent of small sizes of mirror plates, by far the greater part of the glass we use is in the highest bracket* with a considerable portion in the middle bracket, and only a small part in the smaller sizes.

It is true, also, that since our glass is for mirror plates, it must of necessity be of first quality for silvering, and you will see from price lists filed with you that we are paying for our glass at the highest rate per square foot.

You have heard also that the amount of glass of this quality produced in large sizes is limited by the manufacturing process, and that it will, until some radical changes in process are made, continue to command the highest price because of the law of supply and demand.

I do not venture to pass upon the evidence which has been and will be adduced here, but I wish to urge upon the Commission the point that since the furniture industry already carries the burden of the problem of glass manufacture in the difficulty of production and consequent higher prices of large size quality plate, it should not bear also the burden of the highest tariff bracket in case the Commission finds that the cost of production per foot is the same in the large and small sizes.

If, too, the Commission finds as has been suggested that small sizes have been sold or are being sold at less than a fair profit, while the large sizes are sold and can be sold, because of the limited supply, at a sufficient profit to make up a fair average, then we submit that in so far as it lies in its power to do so the Commission should make use of its power for tariff revision to give the user of the larger sized plates the widest access to the production of the world to enable him to offset so far as possible the peculiarly disadvantageous position in which he finds himself by reason of a production problem in glass over which he has no control.

As to the extent of our interest, I have a few figures in regard to the furniture industry.

Extent of Furniture Industry

According to the Biennial Census of Manufacturers for 1923, there are listed 3,043 furniture factories, employing 190,126 persons and producing an output of the value of $776,494,839 annually.

Manufacturers of store furniture, known usually as fixtures manufacturers, are combined with furniture manufacturers in this census report.

In addition to this, as directly connected with the industry, there are 31,816 retailers in the United States, of whom 7,258 are rated at $20,000 or upwards, in accredited commercial reports.

The Commission finds that in the plate glass industry there were, in 1923, seven companies in the United States operating 13 plants. The output of these plants, reported for the complete year 1923, was $65,165,675.

We submit that the Commission should find that the larger interest of the country can only be served by balancing the effect of the proposed tariffs, upon the industries directly affected.

The amount of investment in the furniture industry, the number of wage earners and persons directly interested, under salary or financially, is at last ten times greater than the number of interested persons and the capital invested in the plate glass industry in this country.

In addition to this we must consider that the product of the furniture industry is practically as general in its consumption as food and clothing, and that there is a very widespread consumer interest to be taken into account.

Furniture sales seasons are in January and July, so it is still too early for the reduction in glass prices of August, 1925, to be reflected in furniture prices.

It seems to us also that it may be well worth considering whether or not the Commission should not give thought to the opportunity presented to foreign indebted nations, to trade as freely as possible with this country. While the wealth of the world is so largely concentrated in this country, it is idle to expect a reduction of foreign obligation to us, if trading is prohibited by a tariff wall.

On cross examination MR. MCKENNA (representing the National Plate Glass Company, Edward Ford Plate Glass Company, and Standard Plate Glass Company) said:

Q. What bracket of glass do you use in the one to five or five to ten sizes? A. In the second bracket, over 384 square inches.

Q. Do you get above 720? A. Yes, sir. All cheval glass and large sizes, as you see, 30-40, goes on the larger mirrors, and 28-30 —I think all of those that were in there would embody that. 28-30 is a very common mirror, and all dresser mirrors will go above that.

Demi-Plate in the Furniture Industry

CHAIRMAN MARVIN: Q. Mr. Campau, could you give the Commission any information as to the quantity of domestic mirror plate as compared with imported mirror plate that is used in the production of mirrors by the furniture companies which you represent? A. I know personally, because I have done some clearings in the customs house, that two of our largest concerns get their mirror plate largely from abroad; but aside from that I have no knowledge. What knowledge I have is not worth very much.

Q. Do you know whether or not that mirror plate is cast plate or ground and polished or cylinder glass? A. It is cast plate.

COMMISSIONER COSTIGAN: Q. Is the so-called demi-plate used in connection with furniture? A. No, sir.

MR. MCKENNA: Q. Would you say that is a fact concerning

*For tariff brackets see GLASS INDUSTRY, Nov., 1925, Table 18, p. 245.

the industry generally? You do not profess to know— A. I say this, Mr. McKenna, that the furniture manufacturers in Grand Rapids make only upward from the medium grade of furniture and from that into the finest grades.

Q. Have you ever heard of the Carolina furniture manufacturers using the demi-plate? A. I have heard of them, but I know we have understood generally, and from what I have seen of their line, they do not aim to make the highest grade of furniture. They make what is known in the trade as bread and butter lines. I do not know technically how it works, but I should imagine that they would not have to use in that grade of furniture cast polished plate as we do.

MR. MCCUMBER (appearing for the Pittsburgh Plate Glass Company): Q. Would you not say that from about 75 to 90 per cent of the glass used in the furniture business is of considerably lower grade than this class that you have mentioned? A. I could not say that, because my experience is where the high grade glass has been used.

Q. You purchase from the manufacturer; his cost as charged to you is how much per foot for this glass? (Referring to exhibit.) A. I would have to compute it.

Q. If it is 85 cents per square foot, then the cost price at the place of manufacture would be about $6.75, and then you must add to that the cost of glazing? A. Yes.

Q. That would leave a very high cost of glazing, would it not, to bring it up to the price of $9 which you have given as the value of this particular glass? And silvering; what does it cost to silver? A. I have no idea.

Q. I think it is estimated at about 19 cents a foot; and that would bring this glass very much lower as the cost than you have mentioned under the present sales price.

Opponents of Lower Duties Give Their Evidence

MR. MCKENNA: My appearance is on behalf of the National, the Standard and the Edward Ford Companies, and I believe the views that I express will be concurred in by my associates on this side. And whenever they do not concur in the views I express they will affirmatively express their disapproval of them and their own views.

Our appearance here is two-fold; first, in opposition to the application of the McKim & Cochran Furniture Company, and the Buckley-Newhall Company, in which they request a decrease in the rate of duty on plate glass and mirror glass.

Secondly, an affirmative request that a different way of computing the duty be determined.

In the tentative statement of the Commission and by the Commission under the problems for discussion they take them up in four topical heads. First, should duties assessed on cast polished plate glass be graduated according to the size of the pieces imported, as in the Act of 1922, or should one rate of duty be assessed upon all such glass?

The position of the plate glass industry is now, as it has been for a number of years, as it has been expressed to the Committees of the House and of the Senate as far back as 1921, and I think as far back as 1888, a representative of the entire plate glass industry of the United States declared then in favor of one rate of duty being assessed upon all plate glass, regardless of size.

In the hearings before the Committee on Ways and Means in 1922, at pages 5281 and 5290, the view of the plate glass industry was concurred in by Mr. Charles R. Sligh, of Grand Rapids, representing the furniture manufacturers of the United States through the National Alliance of the Case Goods Manufacturers and the Furniture Manufacturers of the United States composed of manufacturers from practically all parts of the United States with the exception of the Pacific Coast.

Asks Increase in Duties

It is the position of the industry that the duties fixed in the Act do not equalize the difference in the cost of production and that an increase in the duty is imperative to adequate protection of the American industry.

The preliminary statement* of information by the Commission dated October 22 furnishes the latest and only available foreign statistics upon which a flat rate can be based. No cost data relating to the size of plate glass are available. No attempt is made by the manufacturers to keep separate costs of the various sizes of plate glass, nor has any attempt been made to allocate these costs to the various sizes upon which graduated duties are now levied. The cutting of the large plates so as to eliminate these facts and to salvage unavoidable breakage creates plates of all dimensions and results in a high percentage of small sizes. But in view of the fact that separate cost figures are lacking in both the domestic and foreign trade, it is deemed that a duty should be assessed at a flat rate per square foot on all sizes without regard to the dimensions of the plates. In fact, Mr. Vaurie, representing the opposition, the other day testified at page 353 of the record that he knows of no system of determining the entire cost of manufacture of any particular size.

Now, as to the costs shown in this preliminary statement, pages 14 and 20 of the statement show the American and the Belgian costs. A setting up of these costs results in a straight average difference in cost of the American over the Belgian products of .2143 per square foot. That is arrived at by taking the fixed costs shown on these pages 14 and 20 and making a straight average of them. They are respectively .1662, .2264, .2364, .1754, .2356 and .2456, the straight average being .2143 cent.

I cite that because in a previous request made to the Congress, particularly in 1921, request was made for a flat rate of 22½ cents, which very closely approximates the cost figures arrived at in this tentative statement of the Commission.

The Commission's second proposition is: "What are the important distributing centers for plate glass in the United States, both for the imported and the domestic product?"

That will be stated by a witness. I think it is already in the record.

Competition from Cylinder Glass

The third proposition is: "Does imported ground and polished cylinder glass compete with thin cast polished plate glass, and, if so, to what extent and for what purposes?"

There is a question in my mind as to whether the cylinder glass is properly within the scope of your investigation, because, as I read it, the investigation covers only the cast polished plate glass. But there is testimony in the record here to the effect that the main feature in determining what is plate glass is in the grinding and polishing. You will find that on page 351. So it seems that that properly is plate glass, but it does not seem that it is a cast plate glass. That feature of the case, however, represents a matter of very serious import to the plate glass industry, and I think it advisable to put on a witness who will explain very tersely what that glass is and how adversely and injuriously it affects the plate glass industry. The question of competition, in so far as it relates to freight allowances and discounts and breakages, will be covered by a witness.

International Glass Convention

There is another feature of the investigation, namely, the relation of the International Glass Convention to selling prices. In view of the fact that we have no one here who can testify directly to it, I will ask the Commission to take judicial notice of certain hearings in which this so-called International Glass Convention is very thoroughly discussed. Volume 1 of the tariff hearings of the Ways and Means Committee of 1913, pages 836 and 837, 845, 846 and 847; page 620 of the tariff hearings before the Ways and Means Committee in 1921, page 5294 of the 1921 hearings before the House Committee, page 1161 of the 60th Congress, and also the United States Consular and Trade Report of August 18, 1909, pages 2 and 3.

I give those citations merely as an aid to the Commission in its investigation and study of the matter.

Plate Glass Manufacturer Testifies

MR. MCKENNA: I will now call Mr. H. J. Eckenrode.

Q. Are you president of the National Plate Glass Company? A. Yes.

Q. Have you had occasion recently to construct a plate glass factory? A. Yes, sir.

Q. About how large a plant is that? A. It has a capacity of 15,000,000.

Q. And expressed in dollars and cents about a $10,000,000 investment? A. About $10,000,000.

Q. And when was that plant started? A. June, 1923. Q. And it was completed? A. June, 1925.

Q. Prior to the establishment of that plant what consideration, if any, did you give to the installation in that plant of the so-called continuous process? A. We had investigated one concern, the

*See GLASS INDUSTRY, November, 1925, pages 239-249.

Ford Motor Company, and came to the conclusion that we would go along with the old process.

Q. That conclusion was based upon the thought that greater earnings could be derived under the old process? A. That is the way it looked to us, and we went ahead along that line.

Q. Was it the result of your inquiry that the cost of production under the so-called continuous process was materially lower than under the so-called old process? A. We considered it was nothing but an experiment, and we did not want to start in on something we didn't know anything about. We still think it is in an experimental stage.

Q. Did you hear the testimony of Mr. Vaurie concerning the so-called continuous process? A. Yes, sir.

Q. Did you hear what he had to say about the pots? A. I did.

Q. What comment have you, if any, to make about that particular feature of it? A. Well, as to that it would be a long discussion. Mr. Vaurie forgot to mention in regard to the amount of clays they carry on hand for tank blocks, and about the same that they would for pots under the old process.

Q. Did he leave the impression with you that this so-called continuous process was a perfect process and that everything worked harmoniously, with no destruction of batches or none of the evils that you run into in manufacturing in the old process? A. Almost anyone would take it for granted that he did.

Q. Do they ever get bad batches under the new process? A. From what I have been told, they have.

Q. And what is the situation where they have a bad batch under the continuous process as compared with say a bad batch under the old process? A. Well, it is according to the size of the tank. If they have a tank 100 feet long and 30 feet wide, if their tank would go wrong, they would destroy in the neighborhood of 740 tons of glass. In the old process we would probably lose one furnace. If we did, we would lose only 24 tons of glass and not stop our operations in the plant, which the tank would do.

COMMISSIONER COSTIGAN: Q. Have you known of instances in which 740 tons of glass have been destroyed in manufacture? A. Well, from hearsay. I know they ruined up there one tank.

MR. RAFTER (representing Belgian plate glass manufacturers): You were not in a position at the time you started construction of the plant you refer to to determine whether or not the new process was a success? A. No, not exactly. We had observations from one company, the Ford Motor Company.

Q. Was the Highland Park plant of the Ford Motor Company in actual operation at that time? A. Yes, sir.

Q. You are aware of the fact, Mr. Eckenrode, are you not, that at least three of the American companies making plate glass are using the new or continuous process today? A. There are two of them which I know of. The Ford Motor Company and the Pittsburg Plate Glass Company.

Q. The Ford Motor Company originally constructed a plant at Highland Park? And later a larger plant at River Rouge? Isn't it also true that the Ford Motor Company has constructed or is constructing a third plant at St. Paul, Minn? A. A small plant that has not been finished.

Q. Do you know whether or not when the Creighton plant of the Pittsburgh Plate Glass Company was first built it comprised only one unit for the use of this method? A. I believe that is true.

Q. And after that one unit had been in operation for some time a new unit was constructed? A. I understand there is one under construction.

Q. Isn't it also true, Mr. Eckenrode, that the Libbey-Owens Company makes plate glass by a continuous method? A. That is beyond me. I couldn't tell you whether it was making plate glass or whether you call it plate glass. I haven't seen any of it.

Q. Well, assuming that it is plate glass, is it not a continuous method? A. I believe not.

Q. Is it a pot method? A. No, sir. It is a tank proposition with separate machines, grinding and polishing. It is not a continuous grinding at all, sir, according to my understanding. I have never seen the plant.

Continuous Operation Impracticable

MR. GALLERT: Q. Mr. Eckenrode, can a plate glass factory year in and year out maintain its full capacity? A. No, sir. It has to be shut down for repairs.

Q. And in your experience for say during a period of five years how much would the plant fall off from its theoretical capacity, assuming that there was a full demand for its goods? A. You would probably lose a month out of each year.

MR. RAFTER: Q. Mr. Eckenrode, you made some statement regarding the cost of the pots being offset by the cost of the tank blocks? A. Yes, sir.

Q. Isn't it also true that tank blocks were also used under the old method of production? A. No, sir; furnace blocks, that is, in the furnace. I am talking about the tank blocks they would have to carry to run the tanks and to keep them in repair.

Q. You have three tanks in operation? A. Yes, sir. We have four.

Q. How many furnaces are there in those four plants? A. Thirty.

Q. How many pots in each furnace? A. Twenty.

Q. Is it a fact that a pot is used only once in 24 hours? A. Yes, sir.

Q. What is the average life of the pots used for making plate glass? A. 18 to 20 days, or, I would rather say, 16 to 20 days.

Q. How many pots do you have to carry under the old method? A. 250 to 300 for each plant. Our Ottawa plant would carry 250 to 300. The Saginaw plant would carry from 100 to 150, and the Blairsville plant from 200 to 250.

Q. And how many square feet of plate glass are made from a pot of molten glass? A. It is according to the size of your pot. We have different size pots in different plants. In our Blairsville plant we have about 215 to 220 square feet, the average.

Q. What about the new plant at Ottawa? A. Approximately 340 or 350.

Q. Can you state for the benefit of the Commission how long it takes to complete a pot, beginning with the time when the clay is first mined? A. Fifteen days.

Q. Does that take into onsideration all the aging and drying processes? What time must intervene? A. Two months. We use them from two to two and a half or three months, after they are made.

Q. I didn't mean that, Mr. Eckenrode. My question is this. How long a time must elapse between the mining of the clay used for pot-making and the completion of the pot made from that clay? A. We don't mine clay at all.

MR. MCCUMBER: Q. What time did you visit the Ford plant, that is, the continuous one? A. In October, 1923.

Q. When did you begin the construction of your new plant? A. Along in November, that is, the machinery part.

Q. Now, would you mind stating every fact that weighed in fixing your judgment as to manufacturing under the old system? A. Two or three of the engineers I had with me, our engineers, that went through the plant and visited them. They visited the Ford plant on other occasions when I did not.

Q. What were the several factors that influenced your judgment? A. The most important one was the time in grinding and polishing of the glass. They came to the conclusion that it was too slow, that they could grind and polish glass with the round machine quicker than they could with the new process that they were putting up.

Q. And under the new process there was a loss of time in the grinding and polishing? A. That was their decision.

Q. Did you take into consideration the breakage, the loss that would result from the breaking of the tank or pot, as being a factor, and will you make that a little more clear? A. That was their decision, that they figured that if anything should happen to a tank they would destroy more glass in the tank than they would in the single furnace.

Q. Were there any other factors? A. Well, there were a lot of them which I haven't here as evidence and I cannot cite them. Our engineers are not here.

MR. RAFTER: Q. Can you state to the Commission how many employes in all are required to produce glass at that rate which you have mentioned of 17,000,000 square feet per annum? A. I stated we had 2,500 employes in all our plants.

Q. I understood you to say that while abroad you had noticed in some factory the use of a continuous process for grinding and polishing? Would you mind stating in what factory? A. Well, I was in Pilkington Brothers, England. They have one unit in operation.

Q. Was it operating on a commercial scale? A. So far as I know it was in an experimental stage.

Frank E. Troutman Testifies

Frank E. Troutman, president of the Standard Plate Glass Company was called as a witness.

MR. MCKENNA: Q. Is either of your plants now experimenting with the continuous process? A. We have been experimenting at Butler for the past five years on a continuous method of ground and polished glass. Prior to that time we experimented with the tank as early as 1913 to produce glass, but that experiment was discontinued about 1917. Then it was taken up again in the year 1921 and carried on for a year and discontinued.

Q. Have you anything that would supplement the testimony of Mr. Eckenrode? A. I might add that at the present time there are pots being made by a cast method which requires but one day to make the pot. And in conversation with Mr. Gentiel, of the St. Gobain Company on last Friday he told me they were successfully casting their pots abroad. We have cast some very successful pots at our plant.

Ground and Polished Cylinder Glass

MR. MCKENNA: Q. And what would your conclusion be concerning the duty on this imported glass; first, as to whether it should be a graduated scale, and, second, whether it should be a flat basis? A. Of course, I prefer the flat rate.

COMMISSIONER GLASSIE: Q. And you think there shouldn't be any difference in the duty. Now, do you make any difference in the price which you charge for large and for small? A. Yes, sir. Because in the manufacture of glass we start out with a large sheet. When that is poured and cooled at the end of the lehr it is examined for defects, and from then on the glass naturally breaks or is cut for defects, which results in a large accumulation of smaller sizes. If it were not for that, and we could produce and roll out a sheet which would maintain its size all the way through, that element would not enter into it. But glass, being transparent, the defects are readily seen and must be cut out of the plate. And every time you cut the plate you reduce its size.

Q. So when you get a perfect large plate you have something that commands a larger price? A. Yes, sir.

Q. So you have then a thing of value greater than the value which you would arrive at by taking a square foot value of the other pieces and adding them together? A. Yes, sir.

Q. Then you think that these small pieces which result from the operation of making the larger, or attempting to make the larger pieces, should bear the same ratio of cost that is indicated by the mere number of square feet? In other words, that a plate of glass, we will say, that contains 40 square feet—I don't know whether you have it like that—a show window, for example, which contains 40 square feet of good glass without a fault has no more value intrinsically than 40 pieces each a foot square? A. No, not intrinsically, it has no more, except on account of its size.

Q. Then you think that in the total product you get one product which has a greater square foot value than the other and that the one with the lower square foot value should have the same total manufacturing cost attributed to it? A. I cannot see how we can segregate it, because it has the same amount of material and labor spent on it. In fact, the smaller glass has a larger amount of labor spent on it due to the cutting up, and the cutting, of course, figures in the labor and the extra handling of the smaller pieces.

Q. Then, strictly speaking, the small sizes cost more per square foot than the larger sizes? A. I think that would be absolutely true.

Q. Then the larger piece per square foot would have a value five or six times as much as the smaller piece per square foot? A. Yes, sir.

Q. And yet on this system of cost accounting the smaller glass really and strictly costs more per square foot than the large glass? A. Yes, sir.

THE CHAIRMAN: Q. Is there a surplus of the small glass in the process of glass manufacturing? A. There always has been a surplus of small glass.

Q. That accounts for the low price which you are able to get for the small sizes? There is more labor involved in the production of the small sizes, the same material costs, and a slightly higher labor cost, and it is not marketable at as high a price because there is a surplus production of small sizes? A. Yes, sir, that is true.

COMMISSIONER BROSSARD: Q. If there were no accidents in the industry and you could make glass without flaws, how would you regulate the sale of the small sizes which you make, if you had to cut the glass into the sizes you desire? A. If we could make glass like they make cotton goods, I would say the material would sell for so much a yard then, regardless of size.

Q. Would it be any higher for the smaller pieces on account of the greater labor in cutting it? A. I would think so. If you had an accumulation of small sizes, like a drygoods store has, they would probably sell it cheaper. But the principle would be that they would sell at the same value per square foot.

MR. RAFTER: Q. Would you mind stating the total production of both your Butler and Springdale plants? A. Seven and a half million feet for both plants.

Q. And the number of employes required for that production? A. About 600, including about 60 who are making blocks.

Unsuccessful Experiments

Q. You stated you have been experimenting at Butler, Pa., about five years in the grinding and polishing of plate glass by a continuous method? Have you finally adopted that method? A. We have not yet produced a commercial square foot of glass.

Q. Is that method of grinding and polishing with which you are experimenting a patented method? A. Yes, it is supposed to be a patented operation. However, I used the word "supposed" advisedly.

MR. GALLERT: Q. It is the same method being used by Pilkington? A. No, sir.

MR. RAFTER: Q. Do you know whether or not your company owns an interest in the Grice patent for grinding and polishing? A. No, the company does not.

Q. Does anybody connected with the company? A. Yes, sir.

Q. And is that the method which you have been describing? A. Yes, sir.

Q. In producing cast polished plate glass ¼ inch thickness what thickness must you obtain before the first grinding process, approximately? A. 7/16 of an inch.

Q. Do you know whether that is true in the manufacture of plate glass now under the new or continuous method? A. Yes, I can answer that. In the new continuous method glass is made thinner, resulting in the same finished thickness. However, if the continuous method produces glass in the same size sheets as we do, necessarily they would have to cast thicker also. It is very obvious if you have a piece of glass one inch square, to make that perfectly plane surfaced on either side, you take off a very small surface. If you have 240 square feet in it, to produce a plane surface on either side requires considerably more grinding and polishing.

Q. Mr. Troutman, what is the largest size sheet with respect to width now produced under the continuous method of making plate glass? A. To the best of my knowledge, not having seen it, about 70 inches wide.

Q. And, of course, under the pot method the width is much greater, isn't it? A. It is very seldom less than 14 feet wide.

MR. MCCUMBER: Q. Is there any reason why you cannot produce just as wide a glass under the continuous system, if you had the demand for it, as under the other system? A. I see no reason why it cannot be produced very wide.

Q. The only reason then probably that it is not produced is that at the present time it is used mostly for automobiles and furniture, where a smaller glass is required? A. There is no question that is why the continuous method developed—for the automobile and its trade.

Libbey-Owens Glass

Q. Now, is the Libbey-Owens Company producing substantially the same glass that is produced with the so-called continuous method, the ground and polished? A. Yes, sir. The Libbey-Owens people draw glass out flat in a continuous method until the glass is cold. After that—this information I get is first-hand, although I am not permitted to see their factory—it is ground and polished on machines which are not continuous. There are individual machines.

THE CHAIRMAN: Q. Is that glass of a particular width? A. Approximately 60 inches square are the sizes of the plates they lay on each individual machine and polishing table.

COMMISSIONER BROSSARD: Q. Did you come to any conclusions with respect to your experiments in the continuous process of grinding? A. Our conclusions have been rather discouraging up to the present time, and while we are always hopeful, we would not spend any money either way at the present time. In other words, we feel it is still experimental, except for specialized purposes.

Q. You discontinued your experiments because you had arrived at that conclusion? A. Well, we are still continuing to experi-

ment with the continuing grinding and polishing. We have not stopped that.

Q. You are trying to perfect it so that you can use it? A. Yes.

Q. But you have not yet proved to yourselves that it is even usable? A. No, sir, not yet.

MR. MCKENNA: Q. Is the plate production by Henry Ford that is sold to the trade of as high a quality as the average mill run of glass? A. You refer to the continuous process plant? By no means.

Q. Does that tend to depress the price of the old process glass? A. I might give an example. The steel sash requires a small piece of glass, and the Ford Motor Company sell that at much lower prices than our list prices. Naturally we cannot get any of that business at all.

THE CHAIRMAN: Q. They sell what is practically a waste product in their plant? A. That is exactly what it is.

Demi-Plate Again

COMMISSIONER COSTIGAN: Q. You agree with Mr. Eckenrode about demi-plate glass? A. Demi-plate is not ground and polished.

COMMISSIONER COSTIGAN: May I ask Mr. Solomon if that is his understanding also?

MR. SOLOMON: Yes, sir. The demi-plate I made inquiries about. The glass is called Vitrea glass, Vitrea being the name of the manufacturer. "Demi-plate" is simply a nickname started by somebody who imported it into this country They might as well have called it any other name.

THE CHAIRMAN: Do they use it for mirrors? MR. SOLOMON: I have never seen mirrors made of it. It is used sometimes for shelving in small sizes. It is used also by replacement shops, on second-hand cars. For example, a man having an old car would drive up to the replacement shop, and if he does not want to spend the price for plate glass he will tell them to put in the substitute. Formerly they used to use the Libbey-Owens.

THE CHAIRMAN: Does that account for the increased number of accidents? MR. SOLOMON: If they put it in the wind-shields I would say it would.

MR. MCKENNA: Q. Isn't it a fact that great quantities of this so-called demi-plate is used in the furniture industry in Carolina, and is it also very extensively used in the manufacture of fixtures and show-cases?

MR. SOLOMON: I have sold quite a quantity of that glass for various purposes, but I have not sold one square foot to the Carolina Furniture Manufacturers, although I happen to know them. I don't know of any that are using it at all for mirror purposes. So far as furniture or show case people are concerned, I don't know of anyone who uses it other than those who use it for a shelf or something of that nature. They told me that the fronts of the show cases must be of plate glass on account of its appearance, the window glass having a wavy appearance and a ripple appearance.

MR. MCKENNA: Would you say it is also used extensively for tops of tables? MR. SOLOMON: Where do you mean? MR. MCKENNA: In hotel rooms, where "White Rock" will not spill through?

MR. SOLOMON: I have a customer in New York who specializes in that field, and he doesn't handle it at all. He says he has not sold a foot of it.

MR. MCKENNA: Q. Do you know of any instance where this so-called demi-plate was substituted for domestic plate glass? A. Yes, numerous cases in New York City where it was actually substituted, and information was gotten by the Association of Plate Glass Manufacturers of America and action was contemplated being taken, and it was taken up by the Better Business Bureau and by the civic organizations of New York City to combat the substitution of this glass for plate glass. The demi-plate glass coming in with the exact same thickness as plate glass is very easily substituted unless the buyer is aware of the qualities of plate glass.

COMMISSIONER GLASSIE: Q. When you say substituted, do you mean that it is sold as and for plate glass? A. Yes, in quite a number of cases. I believe the insurance companies got out a notice and sent it to their agents. It was published in the New York daily papers, warning the purchaser of demi-plate that it could not be insured as plate glass. There are copies of that available.

Q. Now about Germany. I understood you to say that there was a plant there which had a unit for the manufacture of plate glass under the new or continuous method? A. As regards grinding and polishing only.

Q. Does that same statement apply to the Belgian plant at Auvalais? A. I believe so.

Q. Do you know whether or not the unit which you referred to as having been installed at Auvalais was not simply the installation of a machine for grinding and polishing in one of the existing units? Dou you know whether it was installed for experimental purposes solely? A. No; he did not say.

Consulting Engineer Describes Both Processes

J. W. CRUIKSHANK of Pittsburgh, Pa., was called as a witness. A statement prepared for the State Board of Engineers of Pennsylvania setting forth his engineering training and experience was read.

MR. CRUIKSHANK: I have been in the plate glass industry as a specialist for the last 35 years. I was with the Pittsburgh Plate Glass Company in 1889 as their engineer. Since I have been in practice I built the factory of the American Plate Glass Company at Kane in 1906 and 1907. I have reconstructed most of the plate glass factories in this country—the Standard Plate Glass Company at Butler and Springdale, the Allegheny Plate Glass Company, now owned by the Ford Motors, at Glassmere. I rebuilt that entire plant recently; also for the National Plate Glass Company and for the Edward Ford Plate Glass Company at Toledo. I do work for all the plate glass factories in this country.

I am also retained by the International Plate Glass Syndicate of Europe as consulting engineer. I have quite a few patents on plate glass machinery and equipment.

MR. PRESMONT (appearing for the American Plate Glass Corporation): Q. Mr. Cruikshank, state whether or not you have made an extended study of the so-called new process of making plate glass, the continuous process. A. Yes; I have for the past years been actively engaged in studying and making designs for it.

MR. PRESMONT: Mr. Chairman, while it has been testified to by other witnesses as to the method of making plate glass by the old system and the new system, inasmuch as this witness is an expert, I am going to ask, if it meets wtth the approval of the Commission, that the witness explain in detail the system of making glass by the old process and also the method of making it by the new process.

MR. PRESMONT: Q. Mr. Cruikshank, will you in detail explain the entire proceeding of the making of glass under the so-called old process and the proceeding under the so-called continuous process method of making plate glass?

Describes Old Process

A. In the old process the glass is melted in pots. The furnaces generally contain 20 pots. The glass materials are placed in the pots and melted, and then these pots are taken out of the furnace and conveyed by machine, overhead crane, to the casting table where the glass is poured out in front of a roller and then rolled out on this large table. The table is about 14 feet wide by, in the largest plants, 28 feet long, producing a sheet of some 320 square feet; for the older plants today, 200 to 220 square feet.

From the casting table the glass is pushed off into an annealing oven, the first of a series of five ovens, in what is known as the plate glass annealing lehr. The glass is pushed from one oven to the other oven by this apparatus, and finally lands at the head of the lehr runway in which there is a conveyor consisting of iron rods that carries the glass down some 300 feet to the outlet.

There it is examined and cut—examined for such defects as are apparent in the rough glass, notably bubbles.

After being cut on the cutting tables, it is removed and placed in racks which are known as the rough storage racks. From these racks the glass is taken and laid on large circular tables varying from 24 feet in diameter to 36. These tables are placed under the grinders and the glass is ground, using, first, sand as an abrasive.

From the grinder table it is taken and the joints are cleaned and the abrasives are taken out of the joints and new plaster is put in the joints. Then the table is taken to the polisher. The glass is polished by the medium of rouge, which is a very fine abrasive. Then the glass is turned over on the other side, the polished side down, the rough side up, and taken again to the grinders and ground.

Then the table is taken to what is known as the stripping

yard where the glass is removed from it, placed in the examining frames, examined and marked up by the examiner; then cut into such sizes as are required for the market, or cut for such defects as appear in the glass.

The glass is then placed in the storage racks ready for shipment or ready to be again cut up into what are known as cut sizes if demanded by the purchaser.

A New System Outlined

What is called the new system as exemplified at the Ford Motors at Detroit consists of a continuous melting tank from which the glass flows on to a roller, is rolled out in the form of a ribbon, and it then passes down the annealing lehr which is provided with rollers for conducting the glass along.

At the end of this lehr it is cut into standard lengths or as much standard length as it can be cut to, depending on such defects as may be seen in the glass.

From this point it is taken to the storage of the rough glass and from thence it is taken and laid on the continuous grinders and polishers.

The continuous grinding system consists of a line of tables that are coupled together, a new table always being added at the beginning of the line. These travel very slowly along under fixed grinding heads, and thence pass along under polishing heads.

The first part of the line of these tables is exposed for the purpose of laying the glass on the tables. After the grinders there is another exposed part for jointing or removing plaster and putting new plaster in, just the same as the old system.

At the end of the polishers there is space where the glass is raised up, ready to be turned over. There is a second line in which the same process is repeated.

The tables have a certain length in this long line, and they are removed by a transfer car across to the other line which travels down, and then moved from the second line over the first, so that it practically makes a continuous process.

The line of grinders is provided with different abrasives, first of all, the coarse sand; the next runner would have sand a little finer, and the next one still finer.

At the Ford Motors there are 32 runners, I think, altogether. Of these the first three use coarse sand, the next three finer sand, and so forth, finishing with fine abrasives which consist of pumice stone and garnet; garnet having taken the place of emery which has been used to a large extent but has been recently replaced by garnet.

The Batch Mixture

Q. Mr. Cruikshank, is there any difference in the nature of the mixture used in the tank under the new process than used in the pots under the old process? If so, in what manner would that affect the quality of glass produced? A. It seems to be necessary in order to draw or flow the glass from the tank to make what we call a softer mixture; that is to say, having more soda in the glass and less lime. The result of this is that the glass is not so brilliant, and, when polished, does not take such a high finish as that used in pot glass in the old system.

We have recently made analysis of all of the glass, of all the mixtures used in different processes, and find that this is a fact, that the Ford glass is pretty soft. In the process where they draw the flat sheet the glass is very soft and not comparable at all with plate glass. It is thought that this soft glass will deteriorate with exposure to the weather. In fact, it does. If glass is made soft, the elements will affect it and it will become cloudy or hydroscopic on the surface.

Q. Under the so-called old method the plate is ground and polished on individual units; is not that true? A. Yes.

Q. And under the new method the grinders and polishers are in a series? A. Yes.

Q. What effect would that difference in the two methods have upon the plate produced where there was any effect in any of the machines under the continuous process? A. In the individual system the process can be watched; they can see what they are doing, and if there is trouble they can rectify it.

It is necessary in grinding and polishing plate glass to produce a very exact quality of ground glass, what we call a good smooth glass to be polished, which will take the polish.

In the continuous process where you have 32 runners in line there is an enormous difficulty in knowing what each one of these 32 is doing one after the other, and it is very hard to locate where the trouble lies.

Q. A defect in the nature of a bubble which appears in the glass under the old process—how would that be affected so far as the whole plate was concerned, under the new process? Would it be enlarged? A. The tendency in drawing processes or flowing processes is to elongate the bubbles.

Quality of New Process Glass

COMMISSIONER COSTIGAN: Q. Perhaps I misunderstood you. If so, please correct me. Did I understand you to say that the new process glass is not comparable to plate glass? A. No, I did not say so, but I do not think it is, as far as it has gone at present. A tank may produce an exceedingly good quality of glass at certain times, but it cannot be relied upon to continuously produce good glass.

Q. Do you regard the new process glass as less durable and also as less attractive than the old? A. Yes; it might be. I cannot say that it is less durable, because that is a question that is being studied now. I believe that there are experiments being made to see how the tank glass will stand. If you put silicate of soda in the glass it becomes water glass, and if you have too much soda in it it does not have the lasting qualities that the other glass has.

MR. PRESMONT: Q. As a result of your experience in the plate glass industry and in connection with the study you have given the manufacture of glass under the so-called continuous process method, is it your opinion that that method of making glass is mostly in the stage of experimentation? A. I think it is very much in the experimental stage.

Q. Is it not a fact, Mr. Cruikshank, that you would not recommend as a commercial proposition at this time, that is, considering the experimental stage in which the new process is, the substitution of the new process method for the old method of making plate glass? A. Yes; that is a fact.

COMMISSIONER COSTIGAN: Q. Do you in fact, either in this country or abroad, advise against the introduction of the new process? A. Well, from an engineering standpoint I am very anxious to put in the new system, but I have recommended to one client that until a satisfactory method could be found of producing the rough plate it would not be advisable to put in the continuous grinder because the continuous grinder depends a good deal on the smoothness of the rough glass that can be produced. It would be useless, in other words, to put that in with the present system of casting on the table.

Q. It has been intimated here that approximately 20,000,000 square feet out of about 115,000,000 square feet of glass will have been produced in 1925 by the new process. Granting such figures, do you still consider the new process to be the experimental stage? A. Yes, I do, because the question is as to what width of glass can be produced; secondly, while the glass may be very good, as I said before, at times, I do not believe the tank can be relied upon continuously to produce a perfect sheet of glass.

THE CHAIRMAN: Q. Would you distinguish between the adaptability of this new process and glass needed in large quantity by a concern that used a particular size of glass as between its usefulness for a concern manufacturing glass to meet the general public demand of glass of various sizes? A. Yes; I think I would.

Q. You would not hesitate, possibly, to recommend the use of the new process in a plant whose sole object was the production of glass of a certain width of certain size, which is running on one size of glass? A. Yes, I would feel doubtful about recommending it for that, even, on account of the glass having to be cut. The larger you make your glass the more possibility you have of securing a good quality of small sizes from your large sheets.

COMMISSIONER COSTIGAN: Q. Do you represent the Pittsburgh Plate Glass Co.? A. No, sir; I represent the independent plate glass people who are my clients.

Difference in Cost by Two Processes

COMMISSIONER COSTIGAN: Perhaps some representative of the Pittsburgh Plate Glass Company will informally state whether there is more than one price list for the new process and the old process glass. MR. MCKENNA: It is sold at the same price.

MR. PRESMONT: Q. Is it not a fact that about six months ago at a conversation with the superintendent of the Ford plant

you were told that there was no difference in the cost between the manufacture of plate glass at either the Highland Park plant or the River Rouge plant or the Allegheny plant? A. He stated that they were making glass at about the same cost at the Glassmere plant as at the River Rouge plant.

MR. RAFTER, cross examining: Q. In stating the differences between plate glass made by the old or pot method and the new or continuous method, you have merely been expressing your own individual opinion, have you not? A. No; I would not say that, because I have made a considerable investigation and interviewed a number people on this question.

Q. But you have formed your conclusions and have expressed them today? A. No; I have not formed my conclusions yet; I am still investigating.

Q. Would you mind stating the name of the superintendent who told you that it cost as much to make plate glass at the River Rouge plant of the Ford Motor Company as it does at the Glassmere plant? A. I do not want to quote anybody.

Q. What was his official position with the company? A. General manager. Q. Of which company? A. Ford Motors.

Q. He was not connected directly with the River Rouge plant? A. Oh, yes; he was, absolutely. He had full charge at the River Rouge plant.

Q. Was it just an off-hand statement, or did he go into details? A. It was a general statement.

Q. Did I understand you to say in answer to a question by Commissioner Costigan that from an engineering standpoint you were very anxious to put in the new system? A. Yes, sir.

Q. Why? A. I have quite a big investment in it now in the way of drawings and patents and office overhead and one thing and another that I would like to get out.

Objectionable Features

Q. Is your principal objection, if I may term it objection, to glass made under the new as distinguished from glass made under the old process, an objection to the continuous grinding and polishing? A. I think that there will be considerable trouble in the grinding and polishing. It is more or less experimental; and I think the principal objection is the method of production of the sheet glass both as to quality and obtaining a width of glass that will be commercial.

Q. You stated as part of your objection to the glass made by the new method, if I understood correctly, that the tank cannot be relied on to produce a perfect sheet of glass. Is that a correct summary of what you said? A. No; that it cannot be relied on to continuously produce. If the temperatures are not held very exactly there is a tendency for disintegration to take place, and the whole glass in the tank may go bad, and that is a serious matter. It takes time to clear it up.

Q. Is it not also true that the glass made by the pot method is imperfect? A. Yes, sometimes; but you have individual pots and it is much easier to rectify.

COMMISSIONER GLASSIE: Q. Do I understand that under the tank method the essential difference lies in this, namely, that you have a tank with a very large content and the pouring is more or less continuous; it is not a single operation? A. It is not a single operation; it is continuous.

Q. So that the time element is involved? A. Yes.

COMMISSIONER GLASSIE: So you may have your glass come out at different intervals of time under varying conditions? Is that your point? A. Exactly. I would like to explain this, that in the pot you have an individual pot. The glass is melted in the pot. The glass really boils; that batch of glass boils up and the impurities are taken off, and you get a much finer glass from the melting in the pot. For example, optical glass is always made in pots, and must be.

In the tank method you have this long tank and you start your batch in at the end and then you apply heat to it and melt it, and then you have a certain amount of refining, but you cannot get a definite refining zone. The glass is cooled to a temperature of about 2000 degrees so that it is in condition for this rolling process; but you do not get that definite refining process that you do in a pot.

New Process in Commercial Operation

MR. RAFTER: Q. You are aware of the fact, Mr. Cruikshank, that the Ford Motor Company has three different plants at which plate glass is made under the new method? A. No. I do not think the St. Paul is in actual operation.

Q. You know that the plant at River Rouge was not constructed until some time after the plant at Highland Park had been in actual operation? Do you know what time intervened before the operation of the Highland Park plant and the construction of the River Rouge plant? Do you know that the River Rouge plant was much larger than the Highland Park plant? A. Yes, sir.

Q. You also know that the Pittsburgh Plate Glass Company erected a plant consisting of two units at Creighton, Pa., for the production of plate glass under the new method? A. Yes, sir.

Q. Do I understand you to say that in making plate glass by the new or continuous method the glass is softer than under the old or pot method? A. Yes, sir.

Q. Is that based on actual observation? A. It is based on analyzing the mixtures. There is so much soda and so much lime in the glass, in the composition. That, in the final analysis, is sodium oxide and calcium oxide, and it can readily be seen how much of this soda and how much of the calcium is in the mixture.

Q. Do I understand you to say that soft glass of the type you have been referring to would be less able to withstand atmospheric conditions than the harder glass? A. Yes, sir.

Q. Can you think of any use to which plate glass is put where the atmospheric conditions are more severe than in windshields for automobiles? A. No; but a windshield does not have to last more than two or three years.

Q. Is it true that during the two or three years, or whatever length of time the car may last, the plate glass produced under the new method is sufficient for that purpose? A. That I do not know, because, as I said, the whole question is undergoing tests now to find out.

Q. The analysis which you refer to of mixtures which led you to conclude that the glass under the new method is softer than under the old method—where did you obtain the mixtures? A. At the Ford Motors. The mixtures are on the wall there, and they invite you to take it. I am familiar with the plate glass mixture. Really, it was back in about 1886 along with the standard plate glass mixture, and it is practically the same with very little change today. Not the Standard Plate Glass Company—the standard plate glass mixture.

COMMISSIONER GLASSIE: You mean, the formula is used by all manufacturers? A. Yes, sir. The American Window Glass Company practically uses the same thing.

MR. RAFTER: Q. Do you know whether the mixture used at the Ford plant at Highland Park or River Rouge is any different from the mixture which that company uses at its Allegheny or Glassmere plant? A. Oh, yes. It is a harder glass at the Allegheny plant.

Q. Can you tell from an examination of plate glass whether it is produced by the new or the old method? A. Yes, in some cases, on account of the elongation of the bubbles in the new process. I will not say that all bubbles are elongated, but at least some of the bubbles are elongated, some of the bubbles in glass produced by the new process are elongated.

Q. Are you speaking now of an examination of an entire sheet as it comes from either the pot or the tank, or would the same statement be true as to a small piece of glass cut from the original sheet? A. As to small pieces of glass you cannot tell much about it.

Q. Isn't it a fact that the softness of plate glass has advantages as well as disadvantages? A. I never heard so.

Q. Isn't it easier to put a bevel on plate glass which is soft? A. Well, now, you are referring perhaps to annealing qualities. Glass may be hard in that way, and then, of course, it is bad for working it afterwards.

THE CHAIRMAN: Q. What consideration, as a glass engineer, should be given to the effect of this so-called revolutionary process on the cost of production which the Tariff Commission is supposed to secure? Does it render unusable the cost of production that the Tariff Commission has secured in its present investigation as a fairly representative cost of producing glass in the United States? A. I do not think it is far enough along to consider as a factor at the present time. I do not think that it does render the cost unusable, because while this system may produce glass a great deal cheaper theoretically the question is as to whether in the long run, with your repairs to the melting furnaces, your losses due to bad glass, that the cost would or might be as high as the old process.

The Glass Industry

ESTABLISHED 1920

The First Trade Journal Devoted Primarily to Glass Technology, Engineering, Raw Materials, and Glass Factory Equipment and Operation

Published Monthly

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J. B. KRAK, Technical Editor

To Our Readers, Authors and Advertisers:

Deeply appreciative of the spirit of good will and cooperation manifested toward us during the past year, THE GLASS INDUSTRY takes this opportunity of wishing you all

A HAPPY AND PROSPEROUS NEW YEAR

Vol. 7 JANUARY, 1926 No. 1

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A Quarter Century of Progress

Two public documents of first-rate importance have recently been published, one by the head of the Treasury and another by the Secretary of Commerce. Mr. Mellon in his annual message pictured the past year as one of prosperity for the majority of people, and declared that business conditions warrant optimism for the future. Mr. Hoover reported that through the initiative and cooperation of the Department of Commerce a half billion dollars are saved annually as a result of improved business methods. Some of the achievements claimed are: greater efficiency of the railroads, increased electric generating capacity, expansion of industrial research, stabilizing of business through wider use of statistics, extension of the building season and introduction of simplified practice in many industries.

Of outstanding interest is the statement that while the manufacturing output of the United States has increased more than sixty per cent since 1914, the number of wage earners has increased by only twenty-five per cent. The progress of American industry is due to increased vigilance against preventable waste, more extensive use of the forces of nature and greater intelligence and skill on the part of the workers.

The salient fact of the annual report issued by the Treasury is that fully eighty per cent of the Government costs are due to past wars. The budget shows that in comparison with the enormous figure to be expended as a result of the war, all other government appropriations appear insignificant.

Purely from a standpoint of business the signing of the Locarno treaty is of great significance to America also. The joining of the World Court by the United States would mean increased confidence in the future for all nations. It is expected that the recommendation of President Coolidge in this respect will be carried out, and that the coming quarter of a century will prove that the world has learned the lessons from the past.

The period just closed has witnessed the elevation of this country to a leading position among nations, not through wars of aggression but through the development of its natural resources and the genius of its people. While much has been accomplished, much more remains to be done. Cities must become more inhabitable, housing conditions of industrial workers must be improved, the farmer must receive his share of prosperity, a way must be found to rid the country of its crushing burden of crime. The optimism emanating from official quarters should not blind us to the shortcomings of national, state and local government. We have efficiency in industry. If the next twenty-five years should bring efficiency in government also, this country will surely come into its own.

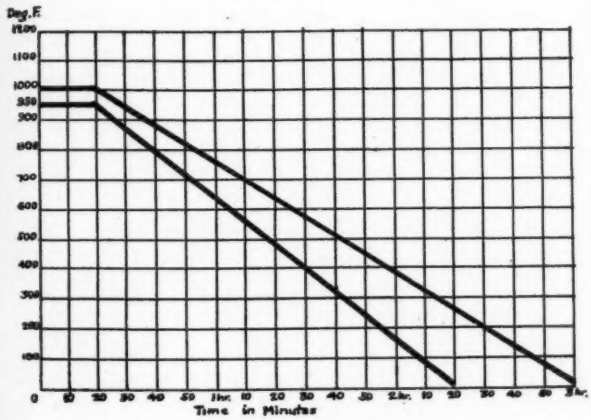
The glass industry has had its full share in the expansion of the past quarter century. We can point with pride to important results in the field of scientific research on the properties and nature of glass. The development of mechanical methods of glass manufacture, practically non-existent in 1900, has placed the United States in the forefront of the glass producing nations. The numerous patents issued are indicatory of great activity in this branch of engineering. There is every reason to believe that the American glass industry will retain its leadership in the years to come.

Technical Consultation Service

QUESTION 85—TEMPERATURE CURVE FOR ANNEALING LEHRS. Can you tell us what the temperature curve should be in the fire box of lehrs for annealing 14 and 16 ounce weight beverage bottles, showing the gradual cooling of it until the bottles come out, the number of minutes the bottle should be in the fire box and at what rate they should be cooled.

ANSWER: The tentative annealing schedule chart shows that the glassware should remain 20 minutes in the fire box of the lehr at 950 deg. F. and should travel through the full length of the lehr in 2 hours and 20 minutes.

Without a knowledge of the composition of the glass it is impossible for us to give you the exact temperature that should be



TENTATIVE ANNEALING SCHEDULE FOR 14 AND 16 OZ. MACHINE MADE BOTTLES.
The correct annealing schedule lies between the two lines.

kept in the fire box. Assuming that the bottles are made by automatic machines, it is probable that they have the following composition:

Silica	74.41%
Sodium oxide	17.20 "
Lime	7.45 "
Oxides of iron and alumina	0.94 "
Total	100.00

This glass would require a temperature of from 950 to 1000 deg. Fahr. in order to remove strains present in the glass. Success in the annealing depends upon cooling the glass without any reappearance of the strain. This probably could be accomplished in from 2½ to 3 hours. For the sake of safety we would prefer to suggest the longer period at the beginning, and then try to speed up the schedule somewhat.

We wish to have it distinctly understood that we are only giving an outline, and that definite figures as to temperature and speed are dependent on the glass composition, wall thickness of the ware, etc.

QUESTION 86—SOURCES OF ALUMINA.—I have followed with interest the discussions concerning the effect of alumina in glass and the best forms in which it may be introduced which have appeared in your journal from time to time. I should appreciate having your viewpoint on the following questions:

Does the potash feldspar have any particular merit above the soda spar, albite, or one of the plagioclases such as oligoclase-andesine. The question really gets down to the effect of potassium oxide as compared to sodium oxide in the batch. The concrete question is whether a substitution of oligoclase-andesine with a large amount of free quartz, the mixture carrying 12 per cent Al_2O_3 and 4.5 per cent alkali, for a potash spar with 18 per cent Al_2O_3 and 12 per cent alkali (10 per cent K_2O) would require that the deficiency of the former in alkali content be made up by the addition of K_2O, or whether Na_2O would serve the purpose. The substitution would be made on an alumina basis, using 1.5 parts of the oligoclase-andesine to 1 of the orthoclase. There appears to be no difficulty as regards melting and fining. The only question is that of the properties of the resultant glass. The product is a flint bottle, machine made.

A possible source of alumina which has not figured in the literature, so far as I know, is the mineral alunite.[1] It normally contains 36-37 per cent Al_2O_3 and 10-11 per cent K_2O. Some friends of mine are developing a deposit in Utah primarily for the production of various aluminum and potash chemicals and they have proved up a considerable tonnage of ore that contains less than 0.1 per cent Fe_2O_3. Would not this mineral have a tendency to function like salt cake to some extent, thus perhaps serving to aid fining and prevent scum formation? It could be sold, I should think, for 3.5 to 4 cents per pound of contained alumina—possibly for even less if a sizable demand could be developed.

ANSWER: For most purposes K_2O and Na_2O are interchangeable in glass, especially in small quantities. Glass containing both K_2O and Na_2O softens at a lower temperature than one of the same composition containing only K_2O or Na_2O. Potash glass is harder and more brilliant than soda glass; the latter softens at a lower temperature.

When calculating the composition of a glass from a batch containing any kind of feldspar, the alkali can be considered as if it were added as K_2CO_3 or Na_2CO_3. In other words, addition of feldspar should be made with regard to the alumina content. The amounts of SiO_2, CaO, K_2O and Na_2O thus introduced should be considered with reference to the amounts of sand, lime and alkali used in the batch.

With regard to the use of alunite it would be interesting to experiment with this material. It is possible that it could be used as a substitute for salt cake. As you know salt cake requires the addition of coal to make the sodium oxide available for the reaction with sand and lime. It is not certain that coal would effect the decomposition of alunite. Since it is not desirable to have more than ½ per cent of SO_4 in glass it is uncertain as to how alunite would act.

---

[1]Alunite or alumstone is a natural basic potassium alum of the composition K_2O, $3Al_2O_3$, $4SO_3$, $6H_2O$. In its pure condition, which is rare in nature, it contains 11.4 per cent of potassium oxide, 37 per cent of alumina, 38.6 per cent sulphuric anhydride and 13 per cent of water.—EDITOR.

QUESTION 87—BATCH FOR AQUAMARINE GLASS.—Please give us a batch for aquamarine colored glass, with and without lead.

ANSWER.—The following batches should be tried out on a small scale:

1. Batch with lead.

Sand	100	lbs.
Potash	30	"
Red Lead	65	"
Nitre	5	"
Copper oxide (Cu_2O)	1½	"

2. Batch without lead.

Sand	100	lbs.
Soda ash	33	"
Marble	16	"
Copper oxide	5	"
Cobalt oxide	0.03	"

Potash lead glass gives a better looking blue than soda-lime glass.

CULLET PILE PHILOSOPHY

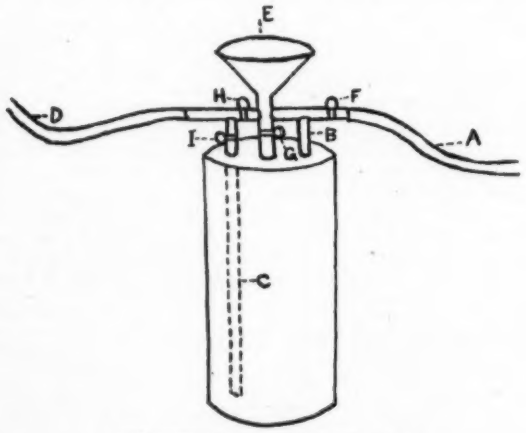
By SILICA SAM

Housecleaning and Interior Decorating in a Glass Factory

The order of the day in industry is unmistakably noticeable as the light, clean, orderly shop. Workmen, as well as executives, now recognize that it is well worth the effort. It is necessary to health, safety and good morale.

The organization with which the writer is fortunate to be connected prides itself in being independent, and while we almost never borrow tools or equipment we do find it absolutely necessary once in a great while to call upon our friends. Thus the calls now referred to were about two years apart.

The first time, we needed two more screw jacks than we have and went over to our friend's shop to borrow them. We found the department head who would have charge of such equipment in his little old, dark, dirty office pawing through some blueprints that were mixed with comic sheets, short story magazines, correspondence, advertisement circulars and what not on top of his desk. Sure we could borrow the jacks—we'd all go down together and get them—they were at the labor gang's shanty. But they weren't. Everything else under the sun was there, dumped in the corners. We went to the storeroom and all over the plant and failed to find the screw jacks. The whole outfit was just the kind of place where one wouldn't be able to find anything. Most everything



HOMEMADE WHITEWASH GUN

was lying where used last. Some half-hearted sweeping may have been done, in some places, two weeks ago last Tuesday, but nothing had been moved. Oil and dirt was caked an inch thick on the floor around machines. Chalk writing and miserable attempts at cartooning adorned the walls. Windows were coated with a film of oil, covered with a layer of dust. They were burning electric lights in the daytime trying to help out, but the lamps and white reflectors were dirty, too. Cobwebs laden with dust until they hung like ropes draped from steel framework overhead. Enough detail. We've all seen such places.

I was back there just the other day to borrow an air hammer, ours had broken down on the job and we couldn't wait for the part we'd ordered. That same department head took me through to the storeroom, where their air hammer was kept and "taken out on order only—to be returned." But it seemed like a different plant. The floor was clean, aisleways were unobstructed and everything seemed neat and orderly. Walls and columns were black to a height of about six feet and above that everything was spotless white. The place was beautiful from end to end. "What's happened around here?" I ventured to ask of my friend. "Oh, that's right,—you haven't been around here since the reformation, have you? Well, you see * * * * * finally got the machine shop foremanship, and he's a nut on keeping a clean place. He just shined his joint up to the point where it made monkeys out of all the rest of us and we just had to follow suit. In fact, we're trying to go him one better in our end."

The above is not fiction and we are not attempting to write a narrative. But it does illustrate what can be done by one department taking the lead and setting the pace.

Another factor is proper equipment. If it is easier to clean up, it'll be done more often. A whitewash outfit illustrates this point. Whitewash is cheap and makes a neat, clean, good appearance when properly applied. Our whitewash gun is proper application exemplified.

A piece of twelve-inch pipe about three and one-half feet long has heads welded in. This forms the tank. Mixed and strained whitewash is filled in through funnel, E, and stopcock, G, is closed. Compressed air is supplied through hose line, A. It can be shut off by stop cock, F. Valve, H, is used to regulate the amount of air that is allowed to go straight through the lines without entering the tank, but in passing through the tee over pipe, C helps by syphoning the whitewash. The flow of whitewash is regulated by valve I. This suction and the pressure of air on the whitewash in the tank together force it out the hose line, D, and through the nozzle in a spray. All hose and pipe is one inch. Nozzles are pipe drawn in a bit at the end. We have a short and a long nozzle for walls and ceiling, respectively. Eighty pounds' air pressure is sufficient to reach a height of thirty feet. The tank is permanently mounted on a two-wheel, stand-up truck.

A pint of household ammonia to two gallons of water makes a solution that will loosen up the coating on windows. It is easy to do with a long-handled whitewash brush. Then they can be simply rinsed off with clean water by a hose, if not too near motors or anything that might be damaged, or by another whitewash brush.

Soda ash, sprinkled around, helps a lot in scrubbing brick or concrete floors. Also, hot water makes a world of difference.

The easiest way is the best way.

Self-respect and high quality products are found in clean plants.

Salvage

The money received for salvage is perhaps not great enough in amount to make it worth while to gather up the paper, the string, the junk, etc., around the plant and ship it but the cleaning up brought about and the influence for economy is worth while. If each department gets credit on its cost sheet for its salvage it will more likely take an interest and try to keep it gathered up and disposed of than if all that could be done were to gather it up and dispose of it on the dump. It will, no doubt, be gathered up by labor that is on the job anyway and for which no special charge is necessary on the cost sheets.

Success

Men commonly fail or succeed in proportion to their innate ability. The attitude of attributing failure to external circumstances causes much ill-being. To acknowledge limitations without losing courage, and to build one's life and work upon what one is, rather than upon what it is pleasant to dream one's self to be, is a health-giving process.

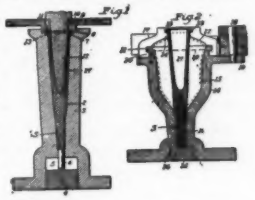
Specific skill in a calling furnishes essential tools of achievement. Without it innate power cannot find expression. Striving for this skill will develop the power which in its full development will achieve success.

Recent Patents

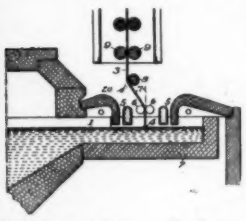
NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

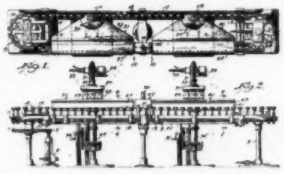
MANUFACTURE OF GLASSWARE. U. S. 1,560,784. Nov. 10, 1925. De Witt C. Hamilton, Sapulpa, Okla., assignor to the Bartlett-Collins Glass Co. Filed 7/16/24. An object of the invention is to provide a method whereby the bowl and stem of a blown article can be formed integrally in one operation from a pressed blank. This method of making stemmed glassware comprises pressing a blank with a stem portion and a hollow bowl portion in a one-piece mold, removing the pressed blank from said mold and placing it in a one-piece blowing mold, blowing the bowl portion of said blank to the desired form, and casting a base or foot onto the lower end of stem.



DRAWING AND FLATTENING SHEET GLASS. 1,561,478. Nov. 17, 1925. William L. Monro, Pittsburgh, Pa., assignor to Window Glass Machine Co. Filed 8/15/24. The method of drawing and flattening a single sheet of glass, which comprises drawing the sheet vertically from a bath of molten glass, deflecting the glass through an acute angle, then deflecting it back into a vertical plane, at least one of said deflecting operations being effected by a flattening roller, and permitting the glass to set free from the contacting surfaces. Such a roller will cause a flattening of the glass, without producing the crizzling and surface defects incident to bending the glass around a roller through an angle of 90° or more, as is the practice in vogue in which the glass is drawn from the bath and then bent into a horizontal position by passage over a roller.



METHOD OF AND APPARATUS FOR GLAZING AND POLISHING GLASSWARE. 1,562,341. Nov. 17, 1925. Albert Breakenridge Knight, Fairmont, W. Va. Filed 12/13/23. A method of treating glassware between the polishing and glazing operations so that the glazing operation may be performed immediately after the polishing operation has been completed, and the provision of a unitary machine for polishing and glazing glasses substantially in a single operation. Also a polishing burner and a glazing burner arranged end to end, means for dissipating the heat from the ware as it passes from the polishing burner to the glazing burner and means for continuously moving the glassware progressively past the polishing burner, the heat dissipating means and the glazing burner.

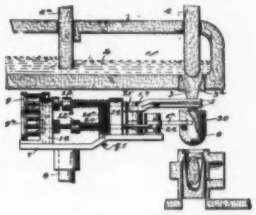


GLASS-WORKING BURNER. 1,562,342. Nov. 17, 1925. Albert Breakenridge Knight, Fairmont, W. Va. Filed 12/17/23.

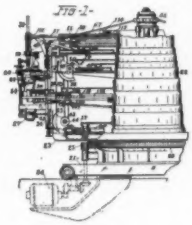
ORNAMENTAL GLASSWARE AND METHOD OF MAKING THE SAME. U. S. 1,561,397. Nov. 10, 1925. Jacob Bass, New York, N. Y., assignor to E. & J. Bass, Inc. Filed 5/2/25. Where glassware was to be provided with metal ornaments it has been heretofore restricted to thin coatings of metal, generally deposited electrically, or to ornaments fastened mechanically.

This inventor claims method of mounting glass jewels, or the like, on an article of glassware, which comprises, electro-plating a layer of metal into the glass, soldering a metallic object having a jewel recess, onto the layer of metal, electro-plating the object and layer to conceal the solder, and fastening the jewel into the recess.

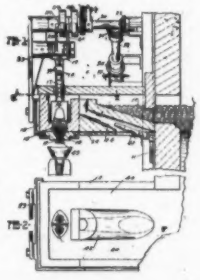
GLASS-FEEDING APPARATUS. U. S. 1,563,935. Dec. 1, 1925. Thomas Stenhouse, Washington, Pa., assignor to Hazel-Atlas Glass Co. Filed 8/12/20. An object is to pivotally mount both the cup members and the shears, and to position the cup members close to the discharge orifice and to position the shears above and close to the cup members, thus preventing the usual spiral formation caused by a long stream, which becomes attenuated when a long drop is required. Also to combine shears of a particular shape with the oscillating cup members, the shears being shaped to surround the glass column during the cutting operation.



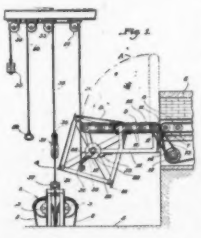
GLASS-FORMING MACHINE. U. S. 1,563,933. Dec. 1, 1925. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co. Filed 10/2/22. A machine in which the extent of cooling of the blank before it is blown in the finishing mold, is materially decreased, as compared with the usual practice, both by reducing the length of time the blank is in the blank mold and also by reducing the length of time elapsing between the opening of the blank mold and the enclosing of the blank in the finishing mold. The inventor provides a mold made in one piece. Provision is made for withdrawing the blank lengthwise from the blank mold and quickly enclosing the bare blank in the finishing mold.



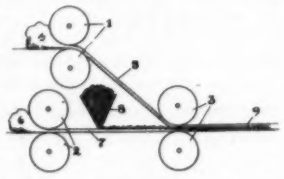
APPARATUS FOR FEEDING MOLTEN GLASS. 1,563,298. Nov. 24, 1925. Leonard D. Soubier, Toledo, O., assignor to the Owens Bottle Co. Filed 5/17/23. The glass issues from an outlet opening 13 formed in a bushing 14 in register with an opening 15 extending through the floor of the boot near the forward end thereof. The movement of the glass through the outlet opening is controlled by a pair of regulating devices each comprising a head or block 16 of fire clay or other refractory material and a stem 17. Metal reenforcing rods 18 extend through the stem 17 and provide means for the attachment of lever arms 19 and 20.



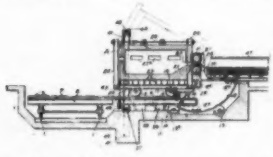
APPARATUS FOR HANDLING GLASS SHEETS. 1,564,267. Dec. 8, 1925. William Owen, Pittsburgh, Pa., assignor to Pittsburgh Plate Glass Co. Filed 2/16/24. The combination with a vertical sheet glass drawing machine, of a counterbalanced clamping device above the machine adapted to engage the upper edge of the sheet being drawn and move upwardly therewith and give it support during and after the cutting off operation, a driven carrier extending laterally from a position at one side of the machine, a transfer frame pivoted beneath the end of the carrier adjacent the machine having a face for engaging the flat side of the glass sheet and laterally projecting means at one end of such face for engaging the lower edge of the sheet and indexing means for the frame for maintaining it in receiving position with said face inclined somewhat away from the vertical.



REFRACTORY GLASS PLATE OR ARTICLES AND METHOD OF PRODUCING THE SAME. 1,563,584. Dec. 1, 1925. Thomas A. O'Shaughnessy, Chicago, Ill. Filed 4/27/21. The plate of glass, embodying the invention, is characterized by plain or substantially smooth opposite surfaces and an intervening medium or means to produce a refractory surface effect. Such intervening means may for example consist of glass of different density from that of the opposite surfaces of the plate and formed or disposed to produce a refractory surface effect. In the form illustrated, the plate is made by supplying fragments of glass between two layers and incorporating the same into a solid sheet or plate while the layers are at fusing heat.

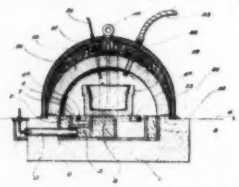


APPARATUS FOR MAKING SHEET GLASS. 1,564,230. Dec. 8, 1925. Frederick Gelstharp, Tarentum, Pa., assignor to Pittsburgh Plate Glass Co. Filed 1/23/22. Where a wide sheet or ribbon of glass is to be drawn practical considerations may impose a limit on the size of melting tanks, and it may be desirable to substitute for the single large continuous tank, a plurality of smaller intermittently working tanks in each of which a part of the glass going into glass ribbon may be reduced.

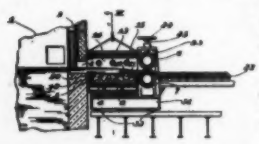


A track system is preferably employed and the tanks carried on suitable carriage or trucks so that the tanks may be brought one after another to the sheet or ribbon forming device placed opposite the end of the annealing lehr. The tanks are preferably arranged for tilting movement.

PROCESS AND APPARATUS FOR MELTING AND FINING GLASS. 1,564,235. Dec. 8, 1925. Alfred L. Harrington, Rosslyn Farms, Pa., assignor to Pittsburgh Plate Glass Co. Filed 12/5/23. A process and apparatus for melting and fining glass by the use of electricity whereby, it is claimed, the heat losses are reduced to a minimum, a very accurate control of temperature secured, the glass is protected from contamination, and a better fining of the glass and an improved product are secured. The glass may be fused and fined in the furnace, but a greater economy results if the fusing of the glass is accomplished in a separate furnace of the ordinary type, after which the pot is transferred to the electric furnace for the fining operation.

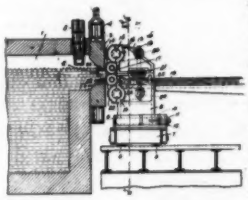


PROCESS AND APPARATUS FOR MAKING SHEET GLASS. 1,564,240. Dec. 8, 1925. H. K. Hitchcock, Pittsburgh, Pa., assignor of one-half to Hitchcock Experiment Co. Filed 2/5/25. A process and apparatus which will enable the glass to be taken continuously from a tank furnace and run through a pair of sizing rolls without elongating the bubbles or seeds. This is accomplished by allowing the glass to flow from the tank onto a liquid supporting bed where the glass spreads itself in sheet form of almost the required dimensions. This preliminary sheet is then passed between a pair of dimensioning or sizing rolls and, as it is reduced very little in thickness during this rolling process, the bubbles are not seriously distorted.

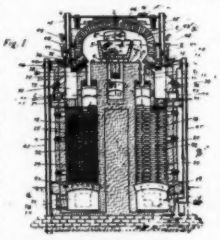


SILICA GLASS. 1,562,115. Nov. 17, 1925. Levi B. Miller, Lynn, Mass., assignor to General Electric Co. Filed 4/1/21. An electric furnace adapted for shaping plastic silica which comprises a container providing a vertical heating zone having a discharge port located at its lower end, an electric heater therefor, a refractory crucible supported in said heating zone and having a die aligned with said discharge port to permit of the extrusion of material therethrough and means for extruding a charge from said refractory container.

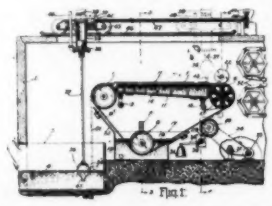
APPARATUS FOR MAKING SHEET GLASS. 1,564,241. Dec. 8, 1925. Halbert K. Hitchcock, Pittsburgh, Pa., assignor of one-half to Hitchcock Experiment Co. Filed 2/5/25. Relates to apparatus for making sheet glass in a continuous operation by flowing it from a tank between a pair of sizing rolls. It has for its principal objects, the provision of improved rolling means, permitting the use of smaller rolls than have heretofore been employed; the provision of rolling means wherein the crumbling or washing away of the clay lips of the outlet slot coacting with the rolls and the consequent contamination of the glass, is reduced to a minimum; and the provision of improved rolling means wherein the formation of severely chilled glass along the lines of approach between the rolls and clay lips is reduced in quantity.



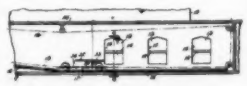
FURNACE. U. S. 1,565,370. Dec. 15, 1925. Nicholas I. Ivanivsky, New York, N. Y. Filed 12/27/24. Refers to regenerative furnaces in which a liquid fuel is gasified before being admitted to the combustion chamber. The object of the invention is to provide a furnace in which fuel is gasified in special regenerative chambers built in connection with main regenerative chambers and adapted to be also heated by the hot exhaust gases from the furnace. The fuel is admitted into these fuel regenerative chambers alternately in accordance with the reversals of the flow of gases. The vaporized and gasified fuel from these chambers is then mixed with the preheated air and burned in the combustion chamber.



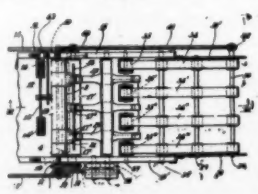
DRAWING SHEET GLASS. U. S. 1,565,363. Dec. 15, 1925. John C. Henderson, New York, N. Y. Assignor to the Libbey-Owens Sheet Glass Co. Filed 8/7/22. One object is to provide an improved sheet glass drawing and conveying means, comprising an endless metallic belt, and improved mechanisms for supporting, driving, cooling and polishing this belt. Also to provide an improved form of bait, for use in starting the sheet drawing process, and improved mechanism for operating the bait so as not to injure the sheet carrying surface of the conveyor.



METHOD OF AND APPARATUS FOR HANDLING CAVE GLASS IN DRAWING OPERATIONS. U. S. 1,566,252. Dec. 15, 1925. Charles A. Smith, Independence, Kans. Assignor to the National Sash & Door Co. Filed 2/24/25. The method of and apparatus for handling cave glass in glass drawing operations, comprising the draining of a glass receptacle under the action of heat, the deposit of said glass in a plastic condition into a receptacle, the transfer of said receptacle with the still plastic glass from the draining station to a melting tank, and the deposit of said glass in a plastic condition into said melting tank.

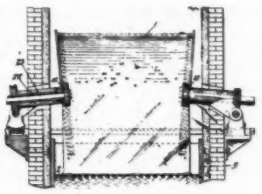


BREAKING AND TRANSFERRING MECHANISM FOR SHEET-GLASS-DRAWING MACHINES. U. S. 1,565,710. Dec. 15, 1925. Thomas B. Campbell, Jr., Pittsburgh, Pa. Filed 4/11/23. A breaking and transferring mechanism for sheet-glass drawing machines comprising an abutment adjacent the path of movement of the drawn sheet, means spaced from said abutment for deflecting the portion of the sheet beyond the abutment away from said path whereby to break the same transversely to form detached sections, and a rotatable carrier dis-

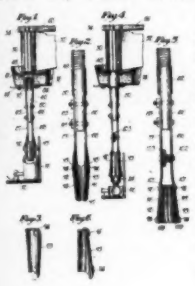


posed at one side of the abutment for receiving the detached sections, said carrier being mounted for free and complete revolution about its pivotal support.

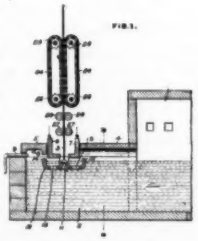
DRAWING SHEET GLASS. U. S. 1,565,364. Dec. 15, 1925. John C. Henderson, New York, N. Y. Assignor to the Libbey-Owens Sheet Glass Co. Filed 11/12/23. The plastic sheet of glass after becoming partially set, is gripped adjacent its edges, and supported upon, suitable members which move the sheet during its bending period, preferably a pair of rather large metal discs or wheels. These edge-supporting members are so mounted that the sheet-supporting surfaces of the two opposite members diverge from one another as they move with the sheet so that a constantly increasing lateral tension is applied to the glass sheet throughout the bending operation. This lateral tension will prevent sagging of the unsupported main central portion of the sheet, which is carried from the vertical into the horizontal plane without contacting with any solid bodies which might otherwise injure the delicate fire-polished surface of the sheet.



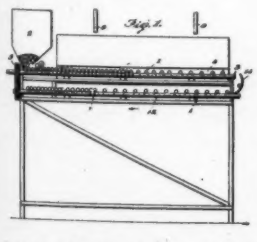
DEVICE FOR GRINDING BOTTLES AND STOPPERS. U. S. 1,562,587. Nov. 24, 1925. William H. Ranagan, Vineland, N. J. Filed 8/8/24. A tool for grinding which comprises, a holding stem, spring leaves mounted in spaced relation, one on each side of said stem, grinding plates, attaching means on said grinding plates to hold the said grinding plates to the free ends of said leaves, each leaf having an opening in its body portion, and a notch in its free end positioned to receive and hold the attaching means provided on said grinding plates. One object is to provide a device which may be readily adjusted for necks or stoppers of different sizes.



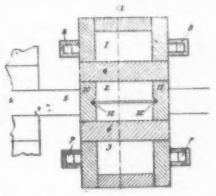
APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,565,821. Dec. 15, 1925. Harry G. Slingluff, Mount Vernon, O. Assignor to Pittsburgh Plate Glass Co. Filed 11/8/21. A sheet glass drawing tank provided with a pair of opposing transverse depending shields spaced apart to provide a drawing opening, a central refractory part extending transversely across the tank beneath the drawing opening and entirely submerged in the glass bath, a pair of transverse refractory parts lying in the drawing tank on either side of the first part with the upper edges thereof lying above the surface of the glass bath, and means for drawing a sheet of glass upward from the bath with its line of generation in alignment with said refractory part.



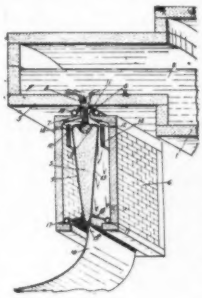
MACHINE FOR MAKING AND FINISHING GLASS BARS, RODS, TUBES, BOTTLE NECKS AND THE LIKE. U. S. 1,565,849. Dec. 15, 1925. Victor Durand, Jr., Vineland, N. J. Filed 9/5/25. Means including two sets of conveyer-screws, the threads of which vary in width somewhere throughout the length of the screws whereby to feed the articles lengthwise thereof and separate them from one another at predetermined points, means for applying heat to the ends of these articles to soften them, conveyer screws for turning the articles having threads pitched to gradually bring them together just prior to their discharge from the conveyer, and gearing for causing two of the conveyer screws to turn in unison in opposite directions, and the other two conveyer screws in unison in reverse direction, whereby the articles are fed first through the machine in one direction, and then through the machine in the opposite direction.



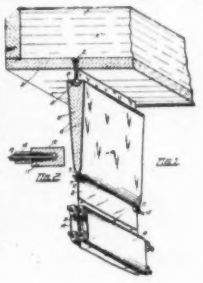
SHEET-GLASS-DRAWING FURNACE. U. S. 1,566,181. Dec. 15, 1925. George Brasseur and Aristide Andris, Charleroi, Belgium. Filed 8/15/23. In a sheet glass drawing furnace, a molten glass compartment, a heating chamber at each of two opposing sides of said compartment, the remaining sides of said compartment being without direct heating, the non-heated sides of the compartment being formed with V-shaped grooves to receive a plate to start the glass drawing from the compartment in sheet form with the edges thereof in contact with the non-heated sides of the compartment.



FORMING SHEET GLASS. U. S. 1,565,319. Dec. 15, 1925. Arthur E. Fowle, Toledo, O. Assignor to the Libbey-Owens Sheet Glass Co. Filed 2/11/24. The method of producing sheet glass, consisting in flowing a stream of molten glass downwardly from a container, highly heating the surfaces of the stream as it emerges from the container, catching the molten glass on the upper end of a directing member down the outer sides of which the glass flows in thin films or streams, cooling the molten streams as they overflow the upper edges of the directing member, and reheating the molten streams as they near the lower edge of the directing member, where the streams are united and drawn away in the form of a single glass sheet.



DRAWING SHEET GLASS. U. S. 1,565,307. Dec. 15, 1925. James C. Blair, Toledo, O. Assignor to Libbey-Owens Sheet Glass Co. Filed 12/26/23. Relates particularly to the art of flowing molten glass down a guiding or supporting slab and drawing this glass downwardly from the slab in sheet form and to the use in such a sheet producing system of auxiliary drawing and guiding means acting only upon the edge portions of the sheet. These means will ordinarily be in the form of pairs of rollers between which the edge portions of the sheet are gripped after the sheet has been formed and drawn downwardly from the guiding or supporting slab.



PROCESS FOR METALLIZATION OF PORCELAIN OR GLASS. 1,558,853. Oct. 27, 1925. Alphonse F. Eyssen, Heerlen, Switzerland. Filed 12/12/24. This relates to a process for rendering objects of porcelain or glass conducting, in order to deposit metals thereon according to a galvanic method. In order to obtain a metallized conducting surface without using a silver salt, glycerol is rubbed with a brush of brass or similar material on to the surface of the object to be metallized, by which treatment a deposit of brass is obtained on the porcelain or glass, which is made conducting in this manner. A little nitrate of silver may be added to the glycerol when silver is desired in the deposit.

REENFORCED GLASS. U. S., 1,560,321. Nov. 3, 1925. George B. Riley, East Dulwich, England. Filed 4/30/25. Reenforced glass of the kind wherein glass sheets are cemented to opposite sides of a sheet of celluloid, characterized in that the glass sheets are treated with a solution containing isinglass and a dextrin gum, the sheet of celluloid is treated with a solution of colophony and castor oil, and the prepared surfaces of the glass and celluloid are united by heat and pressure.

OPTICAL PYROMETER. 1,561,583. Nov. 17, 1925. Francis Edwin Bash, Morristown, N. J., assignor to Brown Instrument Co. Filed 12/13/23.

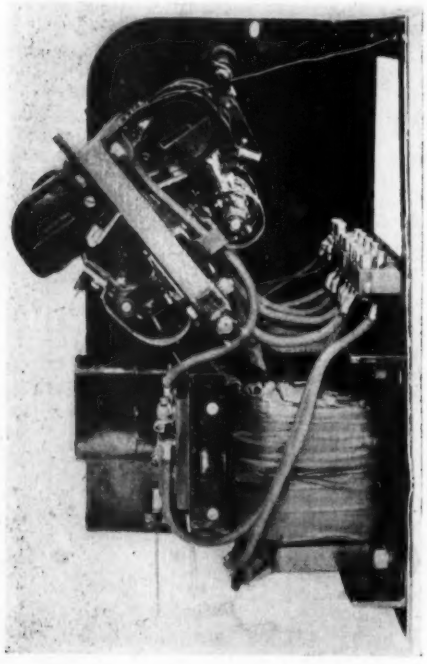
Glass Factory Equipment and Supplies

Most of the information printed in this department comes direct from the manufacturers of the products described.

New Starting Compensator

A new automatic starting compensator, CR-7051-J1, for squirrel cage induction motors, has been placed on the market. This motor starter is for remote control of constant sweep two- or three-phase squirrel cage motors up to 600 volts for general applications driving line shafting, pumps, compressors, blowers, conveyors, etc. With it such equipments may be started or stopped from a distance by means of one or more small hand-operated push-buttons or snap-switches located within convenient reach of the operator or automatically operated by pressure governor, float switch, thermostat, etc.

The General Electric Company, who will manufacture this compensator, has incorporated various new and important features. Definite and adjustable time acceleration is obtained by means of a new induction type relay. Positive overload protection of the complete equipment is obtained by a double pole, inverse time



CR-7051-J1 AUTOMATIC COMPENSATOR
Sectional View With Side Removed. Contactor Base Tipped Forward for Connecting to Terminal Board.

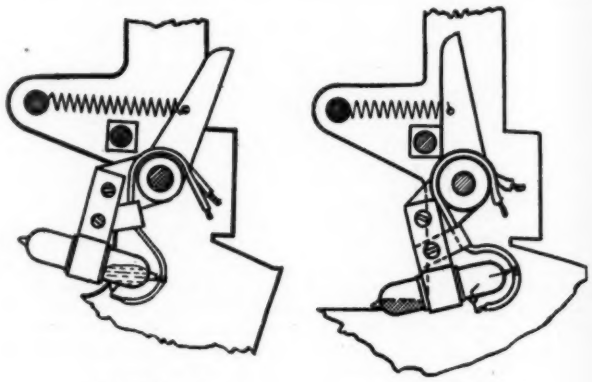
temperature overload relay. The starting and running magnetic contactors are mounted back-to-back in a sheet steel enclosing case providing easy access to all parts. Several taps on the auto-transformer provide for adjusting the low voltage, for starting to suit the requirements of different installations.

All parts are protected by the steel enclosing case and a conduit box at the back has several knock-outs and furnishes entrance for all power and control wires to the motor starter.

Engelhard Develops Mercury Contact Switch

To eliminate electrical contact troubles in connection with pyrometer recorders, the engineers of Charles Engelhard, Inc., 30 Church St., New York, have developed a novel mercury contact switch which is claimed to be unfailing in its operation, abolishes loose connections, and dirty contacts and makes corrosion impossible.

These accompanying sketches show how simple the switch is in its design and how easily it operates. It is simply a small glass tube containing mercury, a minute quantity of oil, and an inert gas. Platinum electrodes pass through the glass and are sealed. In position A the mercury makes contact with both of the



POSITION A POSITION B

electrodes, completing the circuit. To break the circuit the tube is tilted slightly to position B causing the mercury to flow away from the terminals to the other end of the tube.

The maximum angle of tilt required to make the mercury flow back and forth is only 15 degrees when operated with extreme slowness. When tilted quickly as in actual practice in the pyrometer recorder the angle is less.

The switch is very small, the energy required to do the tilting is therefore so slight as to be almost negligible. The switch is absolutely fume proof.

The required number of mercury contacts are all mounted side by side within the recorder case, occupying but little space. For example, where six records are to be made on one chart simultaneously, as is possible with this type of recorder, six separate mercury contact switches are employed one for each circuit.

The resistance is only .003 to .004 ohms, and never varies from these limits. The low and constant resistance of these switches combined with their fume and dust proof features permit this recorder to be used in connection with electric resistance thermometers and thermo-couples where extremely high prcision is required and which would not be at all feasible with any other type of switch.

The manufacturers state that the slight additional cost of this switch makes its use well worth while.

Speed Reducers

Foote Bros. Gear & Machine Company, 237-247 N. Curtis street, Chicago, Ill., announce the publication of a new revised edition of the IXL Speed Reducer Book. This 80-page book contains considerable new engineering information pertaining to the solution of problems involving spur and worm gear speed reducers. It is also replete with illustrations, tables, formulae, practical problems and general information, of considerable interest to engineers and plant executives who have to deal with transmission gearing and speed reduction problems such as occur in glass plants in connection with lehr and elevator conveyor drives, Fourcault sheet and other glass drawing systems.

The Glass World and What It Is Doing

News of the Industry

Prompt Action Requested on Census Returns

Blank forms to be used when making returns to the Bureau of the Census for the biennial census of 1925 will be distributed early in January. Every manufacturer whose gross products amounted to over $5,000 in value must make a return.

The value to the industry of the data collected by the Bureau is greatly increased by their early publication and the Bureau urges all manufacturers to be ready upon receipt of the forms to fill them in and return them as promptly as possible.

Society of Glass Technology

A meeting of the Society of Glass Technology was held in the Coal, Gas & Fuel Industries Department, The University, Leeds, on Wednesday, November 18, 1925, Mr. F. G. Clark, Vice-President, in the chair. Four papers were presented.

1. NOTES ON SOME OLD YORKSHIRE GLASSHOUSES, by Wilfred R. Barker.

2. SOME PROPERTIES OF SILLIMANITE BRICKS AND KAOLIN-SILLIMANITE MIXTURES, by H. S. Houldsworth, M. Sc.

The addition of sillimanite to fireclay or kaolin decreased the drying and firing shrinkages and increased the porosity as well as the refractoriness of the mixtures containing fireclay. Kaolin was more resistant to the solvent action of a soda-lime glass than were kaolin-sillimanite mixtures containing less than 60 per cent of sillimanite. The best results were obtained with test pieces made from a mixture of 66⅔ per cent of sillimanite and 33⅓ per cent of kaolin. The reversible thermal expansion of kaolin-sillimanite mixtures was regular and did not vary appreciably with variations in the percentage of sillimanite present. Some tests on commercial sillimanite bricks were also discussed.

3. SOME EXPERIMENTS WITH SILLIMANITE POTS FOR GLASS MELTING, by A. Cousen, M. Sc., S. English, D. Sc., and Prof. W. E. S. Turner, D. Sc.

From the point of view of the glass manufacturer the question of resistance to corrosion by glass was generally regarded by the glass manufacturer as more important than any other. Experiments were made in which glass batch was melted in pots under specified conditions, and determinations of the alumina and ferric oxide in the glass were used as a measure of the extensiveness of corrosion. The experiments were carried out on two scales: (1) with small pots holding about a pound of glass; and (2) with pots holding about 30 pounds of glass, and tested under continuous running conditions.

In the case of small pots, two series of glasses were employed, namely a soda-lime-silica glass, and a potash-lead oxide-silica glass, both of compositions similar to those widely employed in commerce. With the former series the main conclusion to be drawn was that the glass melted in sillimanite pots contained distinctly less iron oxide than when melted in ordinary fireclay pots. For the potash-lead oxide glasses, the results were similar to those for the soda-lime glasses, the best results being obtained with fine sillimanite, or mixtures containing a preponderance of fine sillimanite. Here also, the color of the glasses melted in sillimanite pots was not so marked as when melted in fireclay pots.

The results obtained with the small pots were sufficiently assuring to warrant the preparation of larger pots: 30 per cent Ball clay with 70 per cent sillimanite was adopted as the standard mixture. The sillimanite mixtures did not work up so easily as ordinary clay mixtures. Shrinkage from the drying state was very small; in fact almost negligible, even after firing at a temperature of 1,500° C. in the interior of the top of the pot. It was found that a pot could have its temperature reduced at the week-end to 600° C. and be raised again on the Monday to melting value without appreciable harm. A number of meltings of glasses of various kinds were made; 24 meltings in one pot and 20 in another. The general results confirmed those carried out on the smaller scale, the iron oxide content of the glasses being considerably lower than would be expected from fireclay pots.

4. A NOTE ON THE CAUSE OF SHOT-HOLING IN GLASSHOUSE POTS, by Percival Marson.

An investigation into the cause for a series of pots failing early in their life owing to shot-holes forming in the lower angle at the bottom of the pots. The hole, no more than ¾-inch in diameter, took a course diagonally downwards through the very thickest portion of the pot, while the remainder of the pot was quite sound. It was eventually found that the batch of clay used for making these pots had been made too soon after wetting up. The plasticity of the clay not being fully developed, the layers of clay, even under the best efforts of the pot maker, failed to unite under the usual pressure of his hand, and this left boundaries along which glass might subsequently find its way.

Owing to lack of time, two other papers on the Agenda were taken as read, namely: (a) NOTE ON A DESIGN FOR A GLASS POT-BOARD, by Francis Winks, B. Sc., Tech.; (b) THE DESIGN OF TANK FURNACES, A CRITICISM AND SOME SUGGESTIONS, by H. W. Howes, M. Sc. Tech.

Two papers read and discussed at the meeting of the Society in London, on December 16, were both provided by the Department of Glass Technology at Sheffield. The first entitled "The Composition of Glass Suitable for Use with Automatic Machines," by Prof. W. E. S. Turner, D. Sc., gave him an opportunity of ranging over the whole field of glass compositions which had been used, particularly for glass bottles, from the time of the Roman glass makers down to the present day. The second paper entitled "The Relationship Between the Durability and the Chemical Composition of Glass," was by Miss V. Dimbleby, and Prof. Turner.

Natural Gas Production and Consumption in 1924 Oklahoma Leader in 1924 Production

The consumption of natural gas in the United States in 1924 amounted to 1,141,482,000,000 cubic feet, the highest on record, according to a preliminary statement recently issued by the Bureau of Mines, Department of Commerce. The figure represents an increase of 13 per cent above natural gas consumption in 1923 and is almost double the 1914 consumption. The estimated value of the natural gas at the wells was $105,779,000, at points of consumption $253,830,000. Production of natural gas in the country in 1924 amounted to 1,141,521,000,000 cubic feet, the slight increase over consumption figures being due to a small consumption in Canada and Mexico of natural gas produced in the United States.

Oklahoma, with a production of 214,452,000,000 cubic feet, led all the states; California, with an output of 189,692,000,000 cubic feet, was second; West Virginia, with 182,285,000,000 cubic feet, was third. Other large producing states were Louisiana, Texas, Pennsylvania, Ohio, Wyoming, Arkansas and Kansas, ranking in the order named. California, with a consumption of 189,692,000,000 cubic feet of natural gas, ranked first in this respect; Oklahoma, with a consumption of 183,451,000,000 cubic feet, was second; and Louisiana, consuming 163,469,000,000 cubic feet, was third.

Increased production, as measured by deliveries to consumers, is recorded for most of the States, and in California, Louisiana and Texas, gains are recorded ranging between 33 and 58 billion cubic feet; but decreased output of natural gas as contrasted with 1923 is recorded in West Virginia, Pennsylvania, Ohio and Montana. West Virginia passed from first in rank among the natural-gas producing States, which rank it had held since 1909, to third place, and Pennsylvania receded from fourth to sixth place. These changes mark the passing supremacy of the eastern States in the production of natural gas and a closer approach in the rank of the natural-gas producing States to those that produce petroleum, and emphasize the increasing use of casing-head gas—the gas obtained from oil wells.

The ratio of domestic (household) to total consumption of natural gas continued to decrease and in 1924 only 25 per cent of the total quantity was used for domestic purposes as contrasted with 27.5 per cent in 1923; with 33.4 per cent in 1922, and with 37.5 per cent in 1921. Nevertheless, the quantity of natural gas utilized by domestic consumers in 1924 increased 6 per cent and the number of domestic consumers in 1924 increased 209,000 to the record of 3,443,000.

The average value of the natural gas consumed for domestic (household) purposes in 1924, ranged from 29.6 per thousand cubic feet in West Virginia to 91.2 cents in Missouri, and for all the States, increased to the record high of 54.0 cents, as contrasted with 51.4 cents in 1923 and with 38.2 cents in 1920. The average value of the natural gas consumed for industrial purposes in 1924 ranged from 2.6 cents in Colorado to 53.2 cents in Maryland and for all the States averaged 11.6 per thousand cubic feet.

The quantity of natural gas reported as treated for extraction of natural-gas gasoline in 1924 was 1,016,276,000,000 cubic feet, which is equivalent to 89 per cent of the total consumption of natural gas in the United States as contrasted with 87 per cent in 1923; 71.5 per cent in 1922 and 62.2 per cent in 1920.

In 1924 there was reported as consumed in the production of carbon black in the United States 156,514,000,000 cubic feet of natural gas which is equivalent to 14 per cent of the total consumption of natural gas. This quantity is almost three times the quantity of natural gas consumed in the manufacture of carbon black in 1922.

Predict Another Six Billion Dollar Building Year

Each year for the past five years *The Architectural Forum* of New York has conducted an extensive survey among architects and builders to determine the amount of building construction contemplated for the ensuing year. The method used includes the obtaining of confidential reports from thousands of sources covering six geographical divisions of the United States in 19 building classifications. These reports are carefully tabulated and correlated and the totals determined by a careful system of weighting. Thus the final forecast figures are established after months of careful research work, and in most cases have proven to be amazingly close to the actual figures shown at the end of the year; and in all cases conservative.

PROBABLE BUILDING TOTAL FOR 1926

The figures for the year 1925 indicate that approximately 6½ billion dollars were spent for new building construction in the United States.

The accompanying table indicates the anticipated expenditures for new buildings during 1926. This tabulation shows the amazing total of $5,584,782,500, which will pass over the boards of architects and into actual construction during the year 1926. In addition to this vast sum to be spent for building materials and labor there must be considered the fact that in the small house field and that of industrial construction there is considerable building not developed from architects' plans, probably totaling another half-billion dollars.

The survey indicates that there will be approximately the same relative building activity in each of the six geographical divisions of the United States during 1926 as compared with 1925 with some decrease in the Northeastern and Middle States and a considerable increase in the Southeastern States, due to activity in Florida.

Successful Glass Distributors Meeting

The annual meeting of the National Glass Distributors' Association at Pittsburgh on December 8 and 9 broke all attendance records for previous occasions of the kind and demonstrated that the trade is in a very satisfactory condition, very much alive and interested in solving distributing problems and very hopeful of a continuance of prosperity throughout the new year, the latter feeling being based on the belief that building construction will continue to reach high figures for a long time to come, and that automobile production will continue on a large scale.

The general session of the association was held on December 9. Addresses were made by Vice-President Wm. J. Schoonover, who presided in the absence on account of illness of President Carey; T. P. Geohegan, of Libbey-Owens Sheet Glass Company; C. J. Gundlach, of Mississippi Glass Company; H. A. Wheeler, of Standard Plate Glass Company; H. B. Higgins, general sales manager, Pittsburgh Plate Glass Company.

W. L. Munro, president of American Window Glass Company, H. S. Binswanger, of Binswanger & Company, E. V. Jacka, of Holbrook Bros., and others also spoke. The annual election was held with the following results: William J. Schoonover, W. J. Schoonover Glass Company, Scranton, Pa., president; D. H. Startsman, Wm. Glenny Glass Company, Cincinnati, first vice-president; A. R. Townsend, Townsend & Company, Los Angeles, second vice-president; North Storms, Chicago, secretary and treasurer.

A Pacific Coast division of the association was established by admitting the former Glass Jobbers' Association of the Pacific Coast to membership in the National organization.

As is customary on the occasion of the distributors' annual meeting, the American Window Glass Company tendered a dinner on Tuesday night, December 8, to glass men from all over the country. Addresses were made by W. L. Munro, president of the American Window Glass Company; James J. Davis, a former glass worker, now Secretary of Labor in President Coolidge's cabinet, who spoke on "Overdevelopment in Industry"; Thomas S. Baker, president of Carnegie Institute of Technology. W. J. Schoonover represented the Glass Distributors' Association.

November Production of Plate Glass

The production of polished plate glass in the United States for the month of November, 1925, announced by P. A. Hughes, secretary, Plate Glass Manufacturers of America, was 9,889,135 square feet, making a total for eleven months, 107,717,911 square feet. Mr. Hughes states that while allowance must be made for the holiday shut down and also for difficulties that may be encountered by some factories in their fuel requirements, due to the severe cold weather, it would be fair to estimate that the production for December should be less than the November production. Taking all this into consideration, he is still of the opinion that the total production for 1925 will reach 115,000,000 square feet.

Annual Forecast of New Building Construction

Building Types	N. Eastern States	N. Atlantic States	S. Eastern States	S. Western States	Middle States	Western States	U. S. A.
Automotive	24,262,500	43,042,500	9,970,000	9,877,500	49,877,500	15,072,500	152,102,500
Banks	18,295,000	55,550,000	10,022,500	22,135,000	59,317,500	20,930,000	186,250,000
Apartments	25,272,500	329,042,500	40,620,000	18,627,500	137,565,000	50,540,000	601,667,500
Apartment Hotels	8,487,500	52,850,000	12,712,500	9,425,000	71,927,500	36,612,500	192,015,000
Clubs Fraternal, etc.	15,837,500	79,845,000	18,437,500	15,727,500	92,137,500	33,697,500	255,682,500
Community Memorial	18,030,000	53,812,500	4,712,500	9,772,500	38,287,500	24,835,000	149,450,000
Churches	39,370,000	79,232,500	17,537,500	41,510,000	78,042,500	28,752,500	284,445,000
Dwellings (Under $20,000)	11,635,000	104,227,500	20,312,500	13,675,000	49,012,500	30,277,500	229,140,000
Dwellings ($20,000 to $50,000)	9,985,000	49,217,500	10,415,000	12,040,000	35,225,000	9,142,500	126,025,000
Dwellings (Over $50,000)	7,295,000	27,372,500	5,287,500	5,807,500	27,985,000	9,737,500	83,485,000
Hotels	45,275,000	131,125,000	59,747,500	40,522,500	240,480,000	68,035,000	585,185,000
Hospitals	35,700,000	112,662,500	8,925,000	16,045,000	87,410,000	49,150,000	309,892,500
Industrial	42,632,500	248,917,500	6,527,500	29,810,000	130,962,500	24,542,500	483,392,500
Office Buildings	38,727,500	240,527,500	38,932,500	37,017,500	212,005,000	96,337,500	663,547,500
Public Buildings	18,597,500	79,242,500	19,760,000	19,325,000	49,057,500	39,382,500	225,365,000
Schools	68,815,000	255,202,500	23,017,500	38,400,000	236,992,500	68,217,500	690,645,000
Stores	8,660,000	38,027,500	11,150,000	7,032,500	43,415,000	14,932,500	123,217,500
Theaters	7,600,000	26,462,500	6,517,500	10,490,000	99,632,500	23,755,000	174,457,500
Welfare, Y. M. C. A., etc.	5,775,000	35,077,500	7,435,000	1,907,500	12,295,000	6,327,500	68,817,500
Total Value of New Buildings	$450,252,500	2,041,437,500	332,040,000	359,147,500	1,751,627,500	650,277,500	5,584,782,500
Per cent	8.1	36.6	5.9	6.4	31.4	11.6	

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James C. Blair at Head of Libbey-Owens

James C. Blair, vice-president of the Libbey-Owens Sheet Glass Company during the past year, was elected December 12 to the presidency of the company, left vacant by the death of Edward D. Libbey last November.

The other officers of the company are B. C. Root, vice-president and general manager; C. A. Schmettau and H. A. Allen, vice-presidents; C. J. Wilcox, vice-president and secretary; R. H. Taylor, treasurer. Executive committee: Blair, Root, Schmettau, Wilcox, and H. L. Hollis. Finance committee: Blair, Taylor, Potter Palmer, Jr., Hollis, and Wilcox.

The two vacancies on the board of directors caused by the death of Edward Drummond Libbey and the retirement of Arthur E. Fowle were filled by the election of Potter Palmer, Jr., of Chicago, and Henry L. Hollis, also of Chicago. Mr. Hollis is engineer and business manager for the Potter Palmer estate.

The new members of the board are said to have been for some time heavily interested in the United States Sheet & Window Glass Company, Shreveport, La.

ANNUAL MEETING

At the annual meeting of stockholders on December 9 the financial report submitted by the board of directors for the fiscal year ended September 30, 1925, gave the following information:

Operating profit after deducting cost of sales and administrative expenses, $3,404,349; other income, $583,011; total income, $3,987,361; less deductions for development, experimental, foreign, patent expenses, etc., $616,829; profit before providing for Federal taxes and contingencies, $3,370,531; provision for estimated Federal taxes and contingencies, $535,000. Net profit to surplus, $2,835,531.

Assets amounting to $19,034,572 include cash, certificates of deposit and U. S. Government securities, $4,171,806; investments in and due from controlled and affiliated companies, $2,762,302; land, improvements, equipment, gas properties, etc., $8,709,301; patents, $965,217; and other items.

Liabilities of $19,034,572 include surplus $5,617,658, capital stock, $11,500,000; reserve for repairs and contingencies, $1,072,495; current accounts payable, accrued taxes, and estimated Federal income tax, $844,418.

The decrease in earnings was largely due to two reductions in price which occurred during the fiscal year. On May 9, the prices of both single and double strength glass were reduced about 12 per cent. On August 10 the prices of heavy glass were reduced about 25 per cent. At the close of the preceding fiscal year, that is, in August, 1924, the prices of single and double strength glass were reduced about 10 per cent and 3/16" about 25 per cent July 1, 1924.

A stock dividend of 20 per cent and an extra cash dividend of one dollar a share was announced, payable January 15, 1926, to stockholders of record on January 5. The annual report states that the company's plant at Charleston, W. Va., was operated at full capacity throughout the year with the exception of interruptions caused by experimental work and the usual furnace repairs.

The grinding and polishing plant at Toledo was reported completed during the fiscal year within the original appropriation. The initial grinding and polishing of glass was commenced on May 5, 1925, although the plant was not fully equipped until June 25 when the installation of its 30 grinding and 36 polishing machines was completed.

The annual report refers to the installation of an enlarged drawing machine at the Charleston plant. This machine is producing from 20 to 25 per cent more glass than the machine it has replaced. In addition to this, it has been making double the amount of large glass, which sells for substantially higher prices than the smaller glass. This machine was designed and placed in operation in six months. The second of these units was put into operation before December 1 and additional units will be installed as rapidly as practicable. When all of these machines are installed, it will increase capacity the equivalent of the original six-machine installation at Charleston.

Secretary Ross C. Purdy Will Remain

It was announced recently by E. Ward Tillotson, president of the American Ceramic Society, that Ross C. Purdy had been persuaded to reconsider and withdraw his resignation as secretary which was received several months ago. In making the announcement Dr. Tillotson said: "Mr. Purdy's success as secretary of the Society and as editor of the *Journal* is recognized within and without the Society and his demonstrated ability in these offices, together with his real interest in the affairs of the Society makes a rare combination for which the Society may well be thankful. Let us all in word and action give united support to Secretary Purdy in his editorial and secretarial work."

Glass Division Offers Interesting Program at Atlanta Meeting

Preparations are going forward for the annual meeting of the American Ceramic Society to be held at Atlanta, February 8-13 inclusive. Divisional meetings will be held on Tuesday and Wednesday, February 9 and 10. A general session of the Society will be held on Thursday forenoon for the presentation of papers of general interest.

At the Columbus meeting last year it was voted to hold four one-half day sessions at the Atlanta meeting of the Glass Division. The sessions were outlined as follows:

1. Popular talks on glass. 2. Papers and discussions in non-technical language for the benefit of manufacturers. 3. Technical papers of a purely scientific nature. 4. A symposium with another Division of the Society.

Following is a preliminary and partial list of papers on glass manufacture and related subjects to be presented at the general and Glass-Division meetings on February 9, 10 and 11.

Electrically heated glass lehrs, by C. L. Ipsen.

Heat transfer in furnaces, by D. J. McSwiney.

The rate of founding and viscosity of glass as related to machine operation, by R. L. Frink.

Comparison of glass manufacturing methods in various countries, by R. L. Frink.

Comparative qualities of German and American fire clay refractories, by R. F. Geller.

Pyrometry, by G. V. Nightingale.

Glass as a factor in civilization, by Dr. A. Silverman.

History and recent progress in the manufacture of plate glass (lantern slides), by J. W. Cruikshank.

An address will be made by F. West, president of the Ceramic Society (England).

Those interested in refractories will find much information of value in papers to be given on the subject, including one by A. V. Bleininger on "The Limits of Our Knowledge of Ceramic Materials"; another by D. W. Ross, of Findlay Clay Pot Company on "Origin of Flint Fire Clays," also a paper "The Deflocculation Effects of Sodium Silicates of Various Soda-Silica Ratios," by S. J. McDowell. Many other papers on subjects concerning the seven divisions of the Society will be presented.

Trips to various points, including Macon, Ga., to visit ceramic plants will be made by those members who are interested. A social program including activities of various sorts for the ladies has been arranged.

The Society is anxious to have as large an exhibit of ceramic materials, factory equipment and ceramic products as possible. The facilities for the display of products by exhibitors have not been equalled at former meetings.

Standardizing Sidewalk and Roof Lights

At a conference of building interests, technical representatives and manufacturers of glass sidewalk and roof lights, held November 18, under the auspices of the Division of Simplified Practice, Department of Commerce, action was taken to have six sizes, two shapes and five styles replace 80 styles, 120 sizes and 10 shapes, previously made in this commodity. The action will become effective March 1, 1926, but in the meantime, various makers of these commodities will put the program into effect as rapidly as possible.

It was explained that the policy of manufacturers has changed in the last three or four years, from one of producing something "different" to a policy of providing sizes and stocks which would permit interchangeability with a minimum of time and effort. There still exists a demand for some of the old sizes, which must be carried for maintenance until the old equipment has worn out.

The three sizes adopted, it was stated, will meet 90 per cent. of today's demand; and the spacing of glass has been developed in a manner which will give the greatest strength without breaking.

L. Willard Mulford, of the American Bar Lock Co., Inc., New York City, stated that the glass light industry has also

developed a relatively new method of setting sidewalk glass in place, using a metal rim, instead of placing it directly in a concrete setting. This, he said, makes for greater safety and long service, virtually permitting all companies installing such glass to guarantee their work, and make free replacement of broken glass for five years. His company, he reported, had had to replace but 24 pieces of glass in installations amounting to more than 1,000,000 pieces during three years.

Among those who took part in the discussions was A. N. Finn of the Bureau of Standards.

Buys Erwin Feldspar Company

Herbert P. Margerum of Trenton, N. J., recently purchased the holdings of the Erwin Feldspar Company, incorporated, and has become the active head of the organization.

The property of the Erwin company includes grinding mills at Erwin, Tenn. along with ten thousand acres of feldspar land located in Avery, Mitchell and Yancey Counties, North Carolina, embracing it is said the largest developed feldspar mines in this country.

Mr. Margerum is president of Golding Sons Company, producers of pottery, tile, sanitary and porcelain manufacturers' supplies, with plants located at East Liverpool, O.; Trenton, N. J.; Hockessin and Wilmington, Del.; Butler, Ga., and Erwin, Tenn., thus bringing together under his direction the two largest feldspar companies in the United States. The policies of the company, it is announced, will only be changed in the direction of further improving the facilities to give greater service.

After January 1, 1926, the general offices as well as the main selling office will be located in the Trenton Trust Company building in Trenton.

Radio Talks on Chemistry

A series of talks on chemistry and human progress, to be broadcast Wednesday evenings at 8:15 P. M., Eastern Standard time, from the University of Pittsburgh Studio of Westinghouse Station KDKA, has been announced by Prof. Alexander Silverman, head, Department of Chemistry.

Jan. 6, Chemistry Advancing Civilization, by Alexander Silverman; Jan. 13, Maintaining a Safe Milk Supply, by Chas. Glenn King; Jan. 20, From Atmosphere to Soil, by Kendall S. Tesh; Jan. 27, Dyes as a Civilizing Factor, by Alexander Lowy; Feb. 3, Explosives and Human Progress, by Gebhard Stegeman; Feb. 10, Speeding Up That Progress, by Carl J. Engelder, and Feb. 17, Where Will Chemistry Lead Us? by Alexander Silverman.

Following the broadcasting of this series, these talks will be printed in Radio Publication No. 21, which may be secured at the conclusion of the series by writing to the Radio Manager, University of Pittsburgh, Pittsburgh, Pa.

Chas. Boldt Glass Company Consolidated with Owens

Early in December it was announced that the Chas. Boldt Glass Company, Cincinnati, O., which for a long time has been controlled by the Owens Bottle Company, would be consolidated with the latter company, effective January 1. The move is interpreted as intended to give the Owens management more complete control of operations. It is believed that the two companies can be operated under one management more economically. The operating and sales departments of the Boldt Company, it is said, will be merged with those of the Toledo concern. The Boldt Company's plants at Cincinnati and Huntington, W. Va., will be added to those operated by the Owens Bottle Company at Toledo, O., Fairmont, Clarksburg, and Charleston, W. Va., and Glassboro, N. J., and to those of the American Bottle Company at Newark, O., and Streator, Ill., as well as those of the Graham Glass Company at Evansville and Loogootee, Ind., and Okmulgee, Okla., all of which are controlled by the Owens Bottle Company.

November Building Breaks Record

Record building volume continued into November according to the F. W. Dodge Corporation. Building and engineering contracts awarded last month in the 36 Eastern States (which include about ⅞ of the total construction volume of the country) amounted to $464,683,100. This is the highest recorded figure for any November, and is 23 per cent greater than the amount recorded in November of last year. There was a seasonal decrease of nearly 11 per cent from October. The strongest influence now holding the building volume up to record proportions is the big increase in New York City activity, largely speculative in character.

"The Low Cost of Dignity and Beauty" is the title of a booklet just published by the Plate Glass Manufacturers of America. The booklet shows by means of photographs and text the added architectural distinction achieved by the use of plate glass in the glazing of residences and the comparative cost of glazing with plate and ordinary window glass. An added feature of interest to all architects and builders is a glossary of terms used in specifications for plate glass. Copies of the booklet may be obtained from the executive offices of the Plate Glass Manufacturers of America, First National Bank Building, Pittsburgh, Pa.

Representatives of the National Window Glass Workers' Association and manufacturers of window glass held a conference at Cleveland early in December, when the workers requested an 8 per cent increase in wages for members east of the Mississippi and 13 per cent increase in western plants. Some of the manufacturers are reported to have offered to compromise on a considerably lower basis, but no final agreement has been announced.

Trade Activities

Roanoke Glass Company, 1516 Jefferson street, Roanoke, Va., is reported to have increased its capital stock from $100,000 to $150,000.

Schwartz-Ornamental Glass Works, 424 West 54th street, New York City, have increased their capital stock from $50,000 to $500,000.

John Dynon & Sons, Ltd., 93 Bathurst St., Sydney, N. S. W. Australia, importers and dealers in glass and glassware, are establishing a plant for the manufacture of tableware.

The Johnstown Glass Company, glass dealers, Johnstown, Pa., has changed its name to the Royal Glass Company. No change in control or ownership has been made.

The Maryland Glass Corporation, Mount Winans, Md., is reported to have awarded a contract for an addition to their plant to the Consolidated Engineering Corporation, Baltimore, Md.

The American Flint Glass Workers' Union offices have been moved from 337-348 Ohio Building, to Rooms 200-210, American Bank Building, corner Huron street and Jefferson avenue, Toledo, O.

The Ohio Glass Products Company, Massillon, O., was recently put into the hands of E. M. Brickell as receiver, following a suit started by the Ohio Box Board Company, asking judgment for $11,132 on account of purchases of packing boxes.

The Premier Window Glass Company, whose plants at Pennsboro, W. Va., and Marietta, O., have been idle for some time, have been proceeded against by creditors. The liabilities are estimated at $280,000 and assets at $150,000.

The Blue Ridge Glass Corporation, Corning, N. Y., has been incorporated to manufacture glassware, with a capital of $30,000. The incorporators are: Halsey Sales, William Flannery and Irving B. Cary, the latter connected with the Corning Glass Works.

Press reports state that **Albert Steiner,** Lancaster, O., and **George H. Lowe,** Bremen, O., have formed a partnership for the manufacture of glass and that an option has been taken on a building in Bremen in which a two pot furnace will be installed. It is stated that the new concern will specialize in automobile stop lights and other products in colored glass.

The Northwood Glass Company, Wheeling, W. Va., which went into the hands of a receiver, D. A. Taylor, last summer, is closing up its affairs and will discontinue business entirely.

It is stated that the value of the stock on hand will take care of all outstanding obligations and that the stock and bondholders will have as an asset the factory property.

The Pittsburgh Plate Glass Company, it is reported, has started work on improvements at their Clarksburg, W. Va., window glass plant which will greatly increase its present capacity. The improvements which it is expected will be completed by February are reported to include two new gas producers.

Fabrica Nacional de Vidrios, Santiago, Chile, have placed with the Vitro Manufacturing Company, Pittsburgh, Pa., an order for three Lynch bottle machines, one Miller feeder and other equipment. This firm, one of the largest in South America, expects to go into the manufacture of bottles on an extensive scale.

Smith & Hemenway Company, Inc., Irvington, N. J., manufacturers of "Red Devil" glass cutters, recently announced through Landon P. Smith, president, that J. F. Hemenway had retired from the company. Mr. Smith will continue in the active management of the business as heretofore. New improvements to buildings and equipment are being planned.

The Eastern Plate & Window Glass Company, Millville, N. J., was recently organized and plans to take over the interests of the Lefebvre Glass Company. The officers of the new company are W. S. Phillips, president; William Rice, Jr., vice-president; H. M. Heckman, secretary and treasurer, and M. F. Lefebvre, manager. It is reported that machinery in a window glass plant at Brownsville, Pa., is being dismantled and shipped to the new company's plant at Millville.

The Fisher Body Company has awarded a contract for the construction of several new units to its plant at Fleetwood, Pa., to **The Austin Company,** engineers and builders, Cleveland and Philadelphia. There will be three buildings, all of steel frame construction. The present capacity of the Fleetwood Metal Body Company is three bodies per week and the new facilities will increase this to ten bodies per day, which will mean an increased consumption of plate glass. The new project will cost approximately $500,000. The Austin Company has agreed to complete the work in 60 working days.

Personals

W. L. Monro, president of the American Window Glass Company, Pittsburgh, Pa., has been elected to the directorate of the Westinghouse Airbrake Company to succeed Charles McKnight.

John H. McNerney, assistant treasurer and assistant secretary, Owens Bottle Company, Toledo, O., was recently placed on the board of directors of the American Bank of Toledo, of which W. P. Clarke is president.

Prof. Alexander Silverman, head of the Department of Chemistry, University of Pittsburgh, lectured before the Maine Charitable Mechanic Association, Portland, Me., December 30th, on "Glass, One of Man's Blessings."

R. L. Frink, the American glass technologist, formerly Director of Research for the Glass Research Association of England and recently with the South Manchurian Railway Company, Dairen, Manchuria, is now located at his old home, Lancaster, O.

C. E. Ralston, safety director of the Pittsburgh Plate Glass Company factories, spoke defining "Safety as a Service to Humanity" at a banquet of the safety committee of that company held in Kokomo, Ind., early in December. R. G. Adare, safety director of American Rolling Mills Company, also spoke on "Fundamentals of Industrial Safety." W. J. Golightly, plant superintendent at Kokomo, presided at the banquet.

Coming Meetings

ASSOCIATED GLASS AND POTTERY MANUFACTURERS AND PITTSBURGH GLASS AND POTTERY EXHIBIT, January 11 to 30, 1926, at Pittsburgh.

AMERICAN CERAMIC SOCIETY annual meeting will be held at Atlanta, Ga., February 8-13, 1926.

THE STAINED GLASS ASSOCIATION OF AMERICA, formerly the National Ornamental Glass Manufacturers Association, will hold its next annual convention next summer in Washington, D. C.

What the World Wants

Specific inquiries for American goods received in the Department of Commerce

Germany. 18078, glass, plates and crystalware.
Syria. 18388, glass, plate, bevelled, plain and silvered.
Mexico. 18400, glassware.

Inquiries Received

For Further Information Address: THE GLASS INDUSTRY

303. Can you give us the name of the manufacturer in this country of an optical glass known as Koylos? (Nov. 21.)
304. What concerns are making glass salt shakers? (Dec. 7.)
305. Where can we procure high grade glass coffee containers in lots of one thousand? (Dec. 17.)
306. Kindly give us the names of manufacturers of glass bird cage cups. (Dec. 14.)
307. (From France.) We would like to get in touch with a reliable firm or individual who could represent us in the United States for the sale of French plate glass. (Dec. 9.)
308. We are desirous of obtaining glass shot, 20 and 60 mesh, in tonnage lots. (Dec. 4.)
309. We would like the names of manufacturers of glass perfume atomizers. (Dec. 10.)
310. (From Japan.) We desire to make a connection for the importation into Japan of small bottles for toilet preparations. (Dec. 22.)

Glass Stock Quotations

Reported by Moore, Leonard & Lynch, Union Trust Building, Pittsburgh, Pa.

PITTSBURGH STOCK EXCHANGE, DECEMBER 23, 1925.

	Bid	Ask	Last
American Window Glass Machine, com...	..	80	79½
American Window Glass Machine, pfd....	..	93	91¼
American Window Glass, pfd.....	109	110	110
United States Glass.....	18½	19	19
Pittsburgh Plate Glass.....	296	..	300
Standard Plate Glass, com.....	6⅝	6¾	6¾
Standard Plate Glass:			
Preferred cumulative	20½	52	33
Prior	75	80	78

Glass stocks showed increased demand during December with Pittsburgh Plate selling at the record price of $300 per share. The unprecedented demand for glass for building purposes has given the market stability. Future quotations for window glass will depend upon whether building activity in 1926 approaches the record total of 1925.

Consumption of plate glass in 1925 will aggregate 130,000,000 sq. ft., about one-half going into the automobile industry. The future progress of plate glass prices depends upon the activity in the automobile industry early in the new year. Present output of plate glass is at capacity.

WHEELING STOCK EXCHANGE, DECEMBER 23, 1925.

	Bid	Ask	Last
Hazel-Atlas	40	42	41
Imperial	45	50	50
Fostoria	125	..	150
Central	..	85	75

The wheeling glass market was fair during December with Hazel-Atlas running at capacity and showing a gain for the month to a last sale of 41.

TOLEDO STOCK EXCHANGE, DECEMBER 23, 1925.

	Bid	Ask	Last
Owens Bottle Machine, common.....	63⅜	63⅞	63¾
Libbey-Owens Sheet Glass, com.....	209	214	212
Libbey-Owens Sheet Glass, pfd.....	110	120	115

Readers Wants and Offers

Wanted—

Representatives in various parts of country with good display rooms and connections to handle one of the best Iridescent Lines in the market. None but experienced glass salesmen need apply.

Address: Durand Art Glass Dept.

VINELAND FLINT GLASS WORKS

Vineland, N. J.

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers.

December 23, 1925

		Carlots	Less Carlots
Acid:			
Citric	lb.	.45½	.45½
Hydrochloric (HCl) 20° carb. ext. per 100	lb.	.90	1.00
Hydrofluoric (HF) 60% (lead carb.)	lb.	..	.13½
52% and 48%	lb.	..	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.25	5.50
Sulphuric (H_2SO_4) 66°	ton	14.00	15.00
Tartaric	lb.	..	.29
Alcohol, denatured	gal.	.50	.55
Aluminum hydrate (Al (OH)$_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	..	..
Ammonium fluoride (NH_4F)	lb.	..	.23
Ammonia water (NH_4OH) 26° drums	lb.	..	.04
Antimony, metallic (Sb)	lb.	.22	.23
Antimony oxide (Sb_2O_3)	lb.	..	.19-.21
Antimony sulphide (Sb_2S_3)	lb.	..	.20
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.03½	.04
Barium carbonate ($BaCO_3$)			
Precipitated	ton	44.00-50.00	47.00-54.00
Natural powdered	ton	42.00-44.00	45.00-46.00
Natural, powdered, imported	ton	38.00	40.00
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05
Barium nitrate ($Ba(NO_3)_2$)	lb.	.07¼	.08
Barium selenite ($BaSeO_3$)	lb.	..	..
Bone ash	lb.	.05½	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.04¾	.05-.05½
Boric acid (H_3BO_3)	lb.	.09	.09¾
Refined	lb.	.10	.10½
Cadmium sulphide (CdS)—			
Red	lb.	..	1.25
Orange	lb.	..	1.10-1.25
Yellow	lb.	..	..
Chromium oxide (Cr_2O_3)	lb.	.30	.32
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide			
Red (Cu_2O)	lb.	..	.30
Black (CuO)	lb.	..	.25
Black prepared	lb.	..	.30
Cryolite ($Na_3Al F_6$)	lb.	..	.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.30
Feldspar—			
100 mesh	ton	11.50-20.00	16.00-22.00
80 mesh	ton	..	..
40 mesh	ton	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	..
" " 90%	ton	38.00	..
Formaldehyde	lb.	.09	.09½
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.02
Black (FeO)	lb.	..	..
Kaolin (f.o.b. mine)	ton	10.00	..
English, lump, f.o.b. New York	ton	13.00-23.00	..
Lead chromate ($PbCrO_4$)	lb.	..	..
Lead oxide (Pb_3O_4) (red lead)	lb.	.12¼	.12½
Litharge (PbO)	lb.	.11¾	.12
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	2.30
Limestone ($CaCO_3$)	lb.	..	..
Magnesia (MgO)—			
Calcined, heavy	lb.	.04½	.05
Light	lb.	.22	.24
Magnesium carbonate ($MgCO_3$)	lb.	.06¼	.06½
Manganese 85% (MnO_2)	lb.	.05	.05½
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	..	19.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.08½	.08¾-.10
Ground	lb.	.11	.12
Potassium carbonate—			
Calcined (K_2CO_3) 96-98%	lb.	.06½	.06¾
Hydrated 80-85%	lb.	.05¾	.06
Potassium chromate (K_2CrO_4)	lb.	..	..
Potassium hydrate (KOH) (caustic potash)	lb.	.07⅛	.07⅝
Potassium nitrate (KNO_3) (gran.)	lb.	.06⅛	.06⅝
Potassium permanganate ($KMnO_4$)	lb.	.14	.16
Powdered blue	lb	..	.26
Rochelle salts, bbls.	lb.	..	.20
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.20	.25
Salt cake, glassmakers (Na_2SO_4)	ton	20.00-22.00	23.00
Selenium (Se)	lb.	..	2.10
Silver nitrate ($AgNO_3$)	oz.	..	.48⅝
Soda ash (Na_2CO_3) dense, 58%—			
Bulk	Flat per 100 lb.	1.35-1.40	..
Bulk, on contract	Flat per 100 lb.	1.35	..
In barrels	Per 100 lb.	1.69	2.40
In bags	Per 100 lb.	1.45	..
Spot orders	.05 per 100 lbs higher		
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.06½	.07
Sodium hydrate (NaOH) (caustic soda)	Per 100 lb.	3.20	3.90
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04¼
95 per cent	Per 100 lb.	2.67	2.75
Sodium selenite (Na_2SeO_3)	lb.		
Sodium fluosilicate (Na_2SiF_6)	lb.	.04½	.05
Sodium uranate (Na_2UO_4)	lb.	..	1.15
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.35	3.65-3.90
Flowers, in bags	Per 100 lb.	3.00	3.30-3.55
Flour, heavy, in bbls.	Per 100 lb.	2.65	2.95-3.20
Tin chloride ($SnCl_2$)) (crystals)	lb.	..	.43
Tin oxide (SnO_2) in bbls.	lb.	..	.66
Uranium oxide (UO_3), 100 lb. lots	lb.	..	1.15
Zinc oxide (ZnO)	lb.	.07½	.07¾

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to November 24, 1925

	October 1924 Quantity	October 1924 Value	October 1925 Quantity	October 1925 Value	Nine Months Ending October 1924 Quantity	Nine Months Ending October 1924 Value	Nine Months Ending October 1925 Quantity	Nine Months Ending October 1925 Value
Glass and glass products (total)	.....	$763,018	.....	$751,744	.....	$7,329,927	.....	$7,210,289
Plate and window glass—								
Window glass, common, box 50 sq. ft.	2,421	13,815	1,312	10,141	31,251	145,459	21,532	125,173
Plate glass, unsilvered, sq. ft.	46,633	22,421	135,253	25,764	1,445,060	436,436	1,182,634	321,798
Other window and plate glass, n.e.s. lbs.	201,481	22,463	358,030	30,405	1,794,295	190,576	2,109,015	235,746
Glass containers (bottles, vials and jars) lbs.	5,341,788	264,627	4,386,113	200,364	51,054,250	2,425,536	52,870,374	2,424,137
Table glassware, plain lbs.	1,746,175	168,741	1,523,826	160,711	13,973,806	1,500,061	14,334,158	1,458,677
Table & other glassware, cut or engraved. lbs.	62,149	19,032	132,285	20,204	437,442	134,225	519,990	131,800
Glassware for lighting—								
Lamp chimneys and lantern globes lbs.	108,019	21,323	137,786	30,355	1,608,896	300,390	1,576,831	291,516
Globes and shades for lighting fixtures lbs.	146,312	37,799	197,285	50,136	1,094,925	327,689	1,360,113	410,232
Lamps and other illuminating devices, chiefly of glass lbs.	73,979	18,918	90,056	23,490	836,336	239,950	715,633	184,832
Chemical glassware lbs.	33,441	22,827	22,311	21,369	201,645	162,759	190,922	161,277
Electrical glassware, except for lighting lbs.	231,082	15,672	186,040	29,416	2,142,202	207,808	2,431,692	239,258
Other glassware, n.e.s. lbs	646,768	135,380	851,991	149,389	7,402,389	1,259,038	6,674,090	1,225,843

IMPORTS

Corrected to November 24, 1925

Glass (total)	.....	$1,575,508	.....	$1,521,674	.....	$16,627,672	.....	$14,605,497
Cylinder, crown and sheet—								
Unpolished, lbs. dut.	1,543,294	84,685	3,867,195	176,284	26,560,352	1,518,662	39,248,524	2,050,646
Bent, ground, beveled, colored, painted, etc., and polished dut.	.....	38,903	.....	26,638	.....	417,167	.....	447,079
Plate Glass—								
Unsilvered, sq. ft. dut.	1,144,599	639,610	1,203,927	402,697	14,808,514	8,948,961	13,344,321	6,184,491
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft. dut.	147,920	30,015	44,692	7,730	2,275,437	313,324	1,042,639	165,310
Containers—bottles, vials, etc. dut.	.....	20,455	.....	14,881	.....	176,872	.....	147,363
Table and kitchen utensils, lbs. dut.	55,831	16,884	88,644	25,733	747,440	166,502	494,604	116,652
Glassware, cut or decorated, lbs. dut.	511,474	235,615	472,011	278,064	3,333,924	1,569,083	3,437,109	1,885,683
Blown glassware, n.e.s—								
Bottles, ornaments, etc., lbs. dut.	1,081,573	274,187	1,143,870	324,731	5,280,837	1,551,969	4,189,483	1,293,882
Bulbs or electric lamps, number dut.	1,434,260	17,544	1,088,904	10,324	12,207,103	168,221	15,185,607	155,807
Chimneys, globes, shades, etc., lbs. dut.	346,544	87,129	389,600	89,729	3,900,931	731,634	4,134,697	899,387
Articles and utensils for chemical, scientific, experimental purposes lbs.	109,912	35,223	74,267	31,652	839,989	289,864	795,659	296,761
Other glassware dut.	.....	95,253	.....	133,211	.....	775,413	.....	962,436